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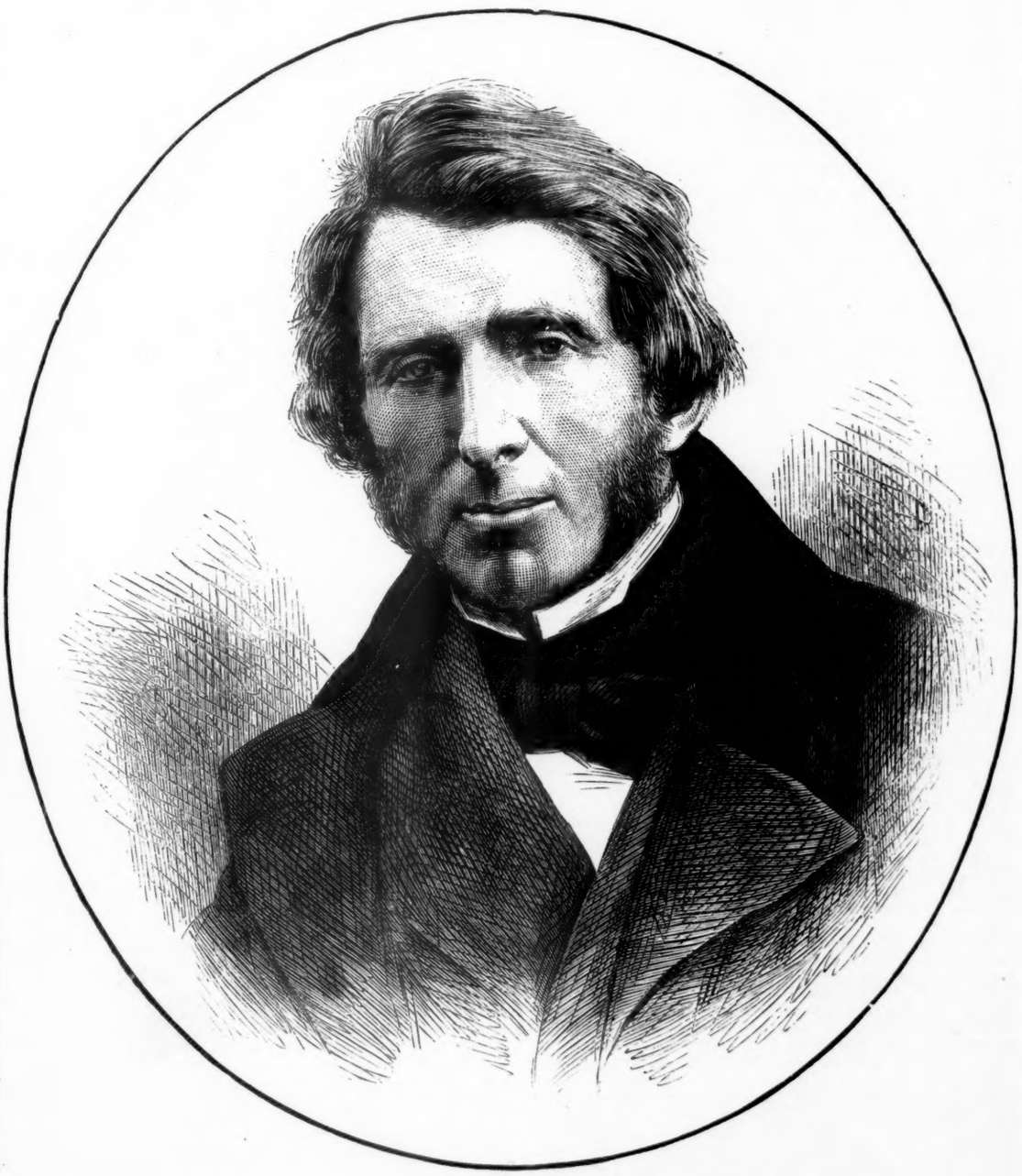

JOHN RUSKIN, ESQ., LL.D.

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INDIVIDUALITY is pre-eminently the characteristic of this distinguished writer and thinker. His views and opinions are absolutely his own, and his many admirers are unable to follow him implicitly: a certain eccentricity pervades his statements, notwithstanding the consummate power that is evident in them all. The son of a London wine merchant of singular integrity, he had all the advantages which wealth and affection, combined with great intelligence, could supply towards his education. He was born in 1819, and in time entered at Christ Church, Oxford, where, at the age of twenty, he carried off the Newdigate prize for English poetry, and took his degree three years after.

We shall endeavour to show the practical side of Mr. Ruskin's teaching in this memoir, avoiding much that is controversial and perhaps visionary, and eliciting some lessons of wisdom and instruction. The courage and power that began a literary career at the age of twenty-three by the publication of *Modern Painters*, and still sustains in unimpaired vigour the same high-toned course, cannot fail to excite the admiration and to stimulate the exertion of students in all ages. Bold in conception and splendid in style and of fixed purpose, *Modern Painters* made a sensation, and brought its author a position of eminence that has never been assailed, and is imperishable. The opinions it contained aroused fierce opposition, but the vigour and genius of the performance irresistibly attracted the attention of all the intelligent classes in the kingdom. From that time to this has the brave writer been indefatigable in labour, shrewd in observation, powerful in speech, and giving us an example of high intelligence in union with an affectionateness of simplicity, concentrating all his powers to the work of educating his generation in the purest principles in art and morals. We propose to limit our observations to this instructing faculty and show the regulating principles he inculcates.

The issue of those great works, Modern Painters, Vol. I, and the greater second volume, and the subsequent Stones of Venice, and Seven Lamps of Architecture, with the issue of many criticisms on art affairs in the *Quarterly*, and in the *Times*, made it inevitable that the censor should become a teacher; and that, happily, is what Mr. Ruskin can join together with success. In 1857 he put forth his *Elements of Drawing* in three letters to beginners, that is to say, persons not younger than twelve or fourteen years of age. Drawing at a younger date should be entirely voluntary: the mere supply of pencils, paper, and common paint box is sufficient. If there be taste it will be seen by the time he mentions, and then the mind will be able to retain knowledge and the taste commence a characteristic development. In later years colour should not be within the boy's reach until he is accurate with his pencil in copying good prints or shades, but it is of primary importance that economical and neat habits be formed, that a correct manner of holding pencil and rule should be acquired, and that parents should, while encouraging, neither check or praise the pupil. Attention and hard work, which make self-denial, is the only thing to be praised.

"All great art," he says, "is delicate; therefore the chief aim and bent of the following system is to obtain first, a perfectly patient, and to the utmost of the pupil's power, a delicate method of work such as may ensure his seeing truly. When once we see keenly enough, there is little difficulty in drawing what we see." To this he adds, "One task, however, of some difficulty, the students will find I have not imposed upon him: namely, learning the laws of perspective. Without a master's help and in the way it is explained in treatises, the difficulty is greater than the gain. For perspective is not of the slightest use, except in rudimentary work..... Its laws are too gross and few to be applied to any subtle form: therefore, as you must learn to draw the subtle form by the eye, certainly you may draw the simple ones. No great painters ever trouble themselves about perspective, and very few know its laws: they draw by the eye..... Turner, though professor of perspective to the Royal Academy, did not know what he professed, and never drew a single building in true perspective in his life..... I recommend the student to treat perspective with common civility, but pay no court to it. The best way he can learn it, by himself, is by taking a pane of glass, fixed in a frame, so that it can be set upright before the eye, at the distance at which the proposed sketch is intended to be seen. Let the eye be placed at some fixed point, opposite the middle of the pane of glass, but as high or low as the student likes: then with a brush at the end of a stick, and a little body-colour that will adhere to the glass, the lines of the landscape can be traced on the glass as you see them through it. When so traced they are all in true perspective."

This is a specimen of this master's method of communicating knowledge; and the positive manner, which might be deemed arrogant, is not so because of the solid foundation of truth, which underlies all his doctrine, and makes every word certain and full. It is not every author that is qualified to say, "I believe that the student, who obeys its directions will find, on the whole, that the best answerer of questions is perseverance, and the best drawing-masters are the woods and hills."

But there is too much material to admit of any analysis of this to us the most important of his practical works, beyond a mere outline. He insists on *work* perpetually, and truly says, "If any young person, after being taught what is in polite circles called 'drawing,' will try to copy the commonest piece of *real work*, such as a music lithograph title-page or a woodcut, they will find themselves entirely beaten, and yet that lithograph was done with coarse chalk, and the woodcut drawn in hot haste and half spoiled in the cutting, and all by persons, who work for daily bread as an handicraft—persons whom nobody thinks of as artists, or praises for their power."

Step by step, as the late Professor A. D' Morgan taught arithmetic, does Ruskin teach drawing, beginning with squares and shading, and conveying the most minute directions interspersed with encouraging cautions, insisting upon slow and accurate work in preference to a dashing style absurdly called freedom in the outlines, but filling in shades lightly and rapidly. The letters are thus divided. 1. On First Practice; 2. Sketching from Nature; 3. Colour and Composition; concluding with an Appendix, Things to be Studied; and along its interesting pages are scattered sketches by the author illustrating his remarks. It is a seven-and-sixpenny book, but its value is more than twenty-fold that sum to the student, and it reveals the author.

Among the many phases of Mr. Ruskin's career, there is one that cannot be unperceived. A seeming inconsistency between some of his minor utterances, when an interval of a few years has occurred. We do not think he is inconsistent; the mind is ever acquiring, and, as years come on, it is conscious of the universality of truth, and ceases to speak dogmatically, or to indulge in paradoxes. Only a few years after the issue of his work on drawing, there appeared, "*The Elements of Perspective* arranged for the use of Schools and intended to be read in connection with the first three books of Euclid." "For some time back I have," said he, "felt the want among Students of Drawing of a written code of accurate Perspective Law; the modes of construction in common use being various, and for some problems insufficient." The book is mathematical; "if the student reads carefully, he will find himself able to solve perspective problems of a complexity greater than ordinary rules will reach, and he will obtain a clue to many important laws of pictorial effect, no less than outline." The author may truly say, "The subject thus treated becomes, at least to my mind, very curious and interesting." He again reminds us of De Morgan, whose work on Algebra followed his Arithmetic as this on Perspective did the one last spoken of on Drawing.

Its style may be judged by a few extracted sentences; and we note them as exhibiting the author rather than to skeletonise his work. "When you begin to read this book, sit down very near the window, and shut the window. Whatever may be the view, we shall find enough to illustrate the first principles of perspective. Every pane of your window may be considered a glass picture. If holding your head still, you extend your head to the glass, you may with a brushful of any thick colour trace roughly the lines of the landscape on the glass." He then instructs the student on "placing of the sight-point, sight-line, station-point and station-line," and passes to state his fifteen problems. For instance, mathematically treated, 1. Is to fix the position of a given point; 2. To draw a right line between two given points; 3. To find the vanishing point of a given horizontal line; and so on. These with corollaries and clearly uttered homely illustrations, make up a treatment of Perspective quite fit for schools, and such as not one educated person out of ten thousand ever saw or heard of.

Akin to this and about the same time Mr. Ruskin in 1859, appeared at the inauguration of the Cambridge School of Art, and there set forth practical instruction, the result of much experience at the Working Men's College in London. It was a School of Art for workmen having two objects, the diffusion of happiness and virtue, and the enabling men to produce better and more valuable work—the one object philanthropic, the other commercial. "The principles of Art Education adopted in a school, which has this wide but somewhat indeterminate aim, are, or should be, very different from those adopted in a school meant for the special instruction of the artizan, in his own business..... We have hitherto asked, under a vague impression, that the arts of drawing and painting might be, up to a certain

point, taught in a general way to every one, and would do every one equal good; and that each class of operatives might afterwards bring this general knowledge into use in their own trade, according to its requirements. Now that is not so. A wood-carver needs for his business to learn drawing in quite a different way from a china-painter, and a jeweller from a worker in iron. They must be led to study quite different characters in the natural forms they introduce in their various manufacture. It is of no use to teach an iron worker to observe the down on a peach, and of none to teach laws of atmospheric effect to a carver in wood. So far as their business is concerned their brains would be vainly occupied by such things, and they would be prevented from pursuing with enough distinctness or intensity the qualities of Art, which can alone be expressed in the materials with which they have to do. . . . .

"It seems to me therefore that all idea of reference to definite businesses should be abandoned in such schools as these. . . . . All specific Art teaching must be given in schools established by each trade for itself, and there will be found an absolute necessity for the establishment of guilds of trades in an active and practical form. . . . . All this for the present we cannot hope for. . . . . We must set ourselves to teach as far as we can, one and the same thing to all; namely, sight. . . . . The main thing you want and ought to ask for is not light, but sight. It does not matter how much light you have, if you do not know how to use it." With two other characteristic passages we must pass from this attractive address. "In reference to the commercial question, namely, how to get from the workman, after we have trained him, the best and most precious work, so as to enable us to compete with foreign countries, or develop new branches of commerce in your own."

"Many perhaps are under the impression that plenty of schooling will do it; that sending abroad for patterns will do it; or that patience, time, or money and good-will will do it: . . . . You may offer any premiums you choose for it—but you will find it cannot be done for premiums. You may send for patterns to the Antipodes—but you will find it cannot be done upon patterns. You may lecture on the principles of Art to every school in the kingdom,—and you will find it cannot be done upon principles. You may wait for the progress of the age—and you will find your Art is unprogressive, or you may set yourselves impatiently to urge it by the inventions of the age—and you will find your chariot entirely immovable either by crew or paddle. There is no way of getting good Art but one—the simplest and most difficult—*to enjoy it*. Examine the history of nations, and you will find this great fact clear and unmistakeable on the front of it—that good Art has only been produced by nations who rejoiced in it; fed themselves with it, as if it were bread; basked in it, as if it were sunshine; shouted at the sight of it; danced with the delight of it; quarrelled for it; fought for it; starved for it; did, in fact, precisely the opposite with it of what we want to do with it—they made it to keep, and we to sell. And this is a serious difficulty for us as a commercial nation," &c.

Once more, "Perhaps some of my hearers this evening may have occasionally have heard it said of me, that I am rather apt to contradict myself. I hope I am exceedingly apt to do so, I never met with a question yet of any importance which did not need, for its right solution, at least one positive and one negative answer, like an equation of the second degree. . . . . For myself I am never satisfied that I have handled a subject properly, till I have contradicted myself at least three times; once must do now. I have just said, that there is no chance of our getting good Art unless we delight in it; next I say, and just as positively, that there is no chance of ever getting good Art, unless we resist our delight in it—we must love it first, and restrain our love for it afterwards." This he justified by showing that when Art has become the servant of pleasure it dies away. Like many of his addresses it deserves to be rescued and a volume compiled from their collection.

A book of Mr. Ruskin's, which incurred the most violent attack of prejudice of any he had written, is the seven lectures on "The Political Economy of Art," delivered at Manchester in 1857. "Political economy" means, in plain English, nothing more than citizens' economy, and its first principles ought to be understood by all who mean to take the responsibility of citizens. The first principles are not in the least obscure; they may be disagreeable in practical requirements, and people pretend they cannot understand because they are unwilling to obey—or rather, by habitual disobedience they destroy the capacity of understanding. The volume treats in the first lecture on economy as the art of managing labour whether in men or nations: we have warped the term, and think it means sparing or saving—a barbarous use. . . . It means administration, stewardship, *applying* your labour rationally, *preserving* its produce carefully, and *distributing* its produce seasonably. . . . You complain of the difficulty of finding work for your men. Depend upon it, the real difficulty rather is to find men for your work. . . . Look around this island of yours, and see what you have to do in it. The sea roars against your harbourless cliffs—you have to build a breakwater and dig the port of refuge; the unclean pestilence ravins in your streets—you have to bring the full stream from the hills, and to send the free winds through the thoroughfare: the famine blanches your lips and eats away your flesh—you have to dig the moor and dry the marsh to bid the morass give forth instead of engulphing, and to wring the honey and oil out of the rock." He illustrates his analogy between a farm and a nation in many choice phrases, and with irresistible force almost insisting on the duty of governments to find employment for the people. Then of discovery—How we are to get men of genius. They cannot be made; they must be *found*. "There is a proportion born annually—you may lose it or gather it, but you cannot make a particle; you can refine it, but cannot create. There may be Leonard de Vincis at work in your harbours: you are not using their golden faculty, but destroying or oppressing it." His wise discourse on Accumulation and Distribution we must put aside, as also the shrewd observations at the end on Trial Schools, Pilots of the State, and kindred items, and quote a little egotism which illustrates the writer's habit of mind.

"I have been much impressed lately by one of the results of the quantity of our books—namely, the stern impossibility of getting anything understood that required patience to understand. I observe, always, in the case of my own writings, that if ever I state anything which has cost me any trouble to ascertain, and which, therefore, will probably require a minute or two of reflection from the reader before it can be accepted, that statement will not only be misunderstood, but in all probability taken to mean something very nearly the reverse of what it does mean. . . . And I see the same kind of misinterpretation put on the words of other writers whenever they require the same kind of thought."

But Mr. Ruskin's artillery rattles in his "Crown of Wild Olive:" three lectures on Work, Traffic, and War. The first delivered at Camberwell, the second at Bradford, and the last at Woolwich. We can only make one extract, and it occurs to us that here the most suitable will be from the lecture on Work.

"Then, secondly, wise work is USEFUL. No man minds, or ought to mind, its being hard, if it only comes to something; but when it is hard, and comes to nothing, when all our bees' business turns to spiders', and for honeycomb we have only resultant cobweb, blown away by the next breeze, that is the cruel thing for the worker. Yet, do we ever ask ourselves personally, or even nationally, whether our work is coming to anything or not? We don't care to keep what has been nobly done; still less do we care to do nobly what others would keep; and, least of all, to make the work itself useful instead of deadly to the doer, so as to use his life indeed, but not to waste it. Of all wastes, the greatest waste that you can commit is the waste of labour." He tells a story about a child spilling milk, and then—"But if, instead of wooden bowls with milk in them, there are golden bowls with human life in them, and instead of the cat to play with, the devil to play with; and you yourself the player; and instead of leaving that golden bowl to be broken by God at the fountain, you break it in the dust *yourself*, and pour the human blood out on the ground for the fiend to lick up—that is no waste! What! you perhaps think, 'to waste the labour of the men is not to kill them.' Is it not? I should like to know you could kill them more utterly—kill with second, seventh, hundredfold deaths. It is the slightest way of killing to stop a man's breath. . . . If you put him to base labour, if you bind his thoughts, if you blind his eyes, if you blunt his hopes, if you steal his joys, if you stunt his body and blast his soul; and at last leave not so much as to reap the fruit of his degradation, but gather that for yourself, and dismiss him to the grave when you have done with him, having, so far as in you lay, made the walls of that grave everlasting, . . . this, you think, is no waste and no sin!"

Turning from these points in Mr. Ruskin's illustrious services to a more technical department, we will notice his "Ariadne Florentina:" six lectures on Wood and Metal Engraving, given before the University of Oxford in 1872, and also ten lectures (Eagle's Nest) on the relation of Natural Science to Art, given that same year in his capacity of Slade Professor of Fine Art there.

A quaint fashion has Mr. Ruskin of attaching classic names to treatises that in the general judgment had better be described in ordinary terms. The "Crown of Wild Olive" above mentioned is really three lectures on Work, Traffic, and War. This book about Engraving has the title "Ariadne Florentina." No doubt, a father has the right of naming his own children, and the titles, although quaint, are accurate; but they do not index the contents or object of the treatise they represent. So of the Fors Clagivera, of which we shall say something presently. However, it is only with a deferential remonstrance that the

objection, or rather remark, is made, and entirely in the interest of diffusing the truth Mr Ruskin is so mightily qualified to proclaim. One feels that a man who has considered his duty ought to know best the way of doing it, and there is evidence everywhere that, even in what might be designated rhetorical passages, there is intense feeling and vehement thought. Every now and then this crops up in what might be styled fragments of autobiography.[1] "None of my writings are done fluently; the second volume of "Modern Painters" was all of it written twice—most of it four times—over; and these lectures have been written I don't know how many times. You may think that this was done merely in an author's vanity, not in a tutor's care. To the vanity I plead guilty—no man is more intensely vain than I am; but my vanity is set on having it *known* of me that I am a good master, not in having it *said* of me that I am a smooth author. My vanity is never more wounded than in being called a fine writer, meaning, that nobody need mind what I say.

The Eagle's Nest preceded Ariadne. They are, in fact, one series. "It sometimes takes me a week to think over what it does not take a minute to say." "The least part of the work of the sound art-teacher must be his talking." "Conquer the old habit of considering what is to be said than what is to be known." These extracts introduce the subject of natural philosophy in relation to art, with this one added, "Perhaps you think that the triple powers of science, art, and scholarship mean simply the powers of knowing, doing, and saying. It is not so. In science, you must not talk before you know. In art, you must not talk before you do. In literature, you must not talk before you—think." This first lecture describes the Wisdom and Folly in Art. The second does the same for Science. The third, the Relation of Wise Art to Wise Science. These are followed by the Power of Modesty in Science and Art; Contentment in Science and Art, from which lecture an extract may be useful to the reader engaged in controlling or in working: "Be assured that you can no more drag or compress men into perfection than you can drag or compress plants. If ever you find yourselves set in positions of authority, and are entrusted to determine modes of education, ascertain first what the people you would teach have been in the habit of doing, and encourage them to do that better. Set no other excellence before their eyes; distrust none of their reverence for the past; do not think yourself bound to dispel their ignorance, or to contradict their superstition; teach them only gentleness and truth; redeem them by example from habits which you know to be unhealthy and degrading; but cherish, above all things, *local associations* and *hereditary skill*."

After having defined the manner in which the mental tempers retard or advance science and art, Mr Ruskin discourses on the liberal modes in which the virtues of art are connected with the principles of exact science, and in the concluding lectures expounds the relation of art to mythology and heraldry. The reader must feel the marvellous originality of the teacher, who, under forms and terms seemingly incongruous, conveys the tersest and keenest thoughts of the most practical kind. "This, then," he says, "is, I repeat, the sum of education. All literature, art, and science are vain, and worse, if they do not enable you to be glad, and glad justly." We cannot read these books without being both instructed and glad. The next course, Ariadne or Engraving, followed in the autumn. In that, after many preliminary suggestions, he says: "Engraving, then, is the Art of Scratch. It is essentially the cutting into a solid substance for the sake of making your ideas as permanent as possible, graven with an iron pen in the Rock for ever. *Permanence*, not multiplicity—that is accidental, and not always desirable. . . . Scratchable solids are essentially three—stone, wood, and metal. We have then three schools of engraving. . . . All engraved work is Athletic; it is Resolute; it is Obedient." The mind is strong, determined, and self-controlled. The reader will see what an extensive field is thrown open, and that a multitude of suggestions are evolved.

The methods of manual execution is then discussed. It depends on the Hand; sometimes it receives and obeys orders, and sometimes it is independent, or gives its own orders. The dependent is a noble hand; the independent a vile one. So long as the graver is under the influence of mental attention, it works nobly; if independent and dexterous, it is base. Modern art is full of sinisterity. Hands independent of brains. All engraving is intaglio on the solid; if wood, a coarse substance easily cut; if metal, a fine substance not easily. In metal, you cut ditches, fill them with ink, and press paper into them; in wood, you have ridges, rub the tops with ink, and stamp them on the paper. The instrument is the same. It is a ploughshare. In wood printing, you print from the surface left solid; in metal, from hollows. A sketch on wood is a careful *imitation* of a sketch on paper; a sketch on metal *is* one. If we try to produce effects of sketching in wood, and of finish in metal, our work is wrong. Sketches on wood should be firm and deliberate. Engravings ought to look like free ink sketches on white paper. Wood cutting should be careful. Metal cutting should be slight and free. In metal engraving it is easier to lay a fine line than a thick one, and it lasts. In wood, it requires extreme precision and skill to have a thin dark line, and then it may be quickly beaten down by a careless printer. The virtue of wood engraving is in thick lines; in metal, thin ones. Thin dark lines in wood should be used only in necessity, and thick on metal only in necessity.

We have given this bare outline of a most interesting lecture on the Technics of Wood Engraving, and leave the rest. The reader is only introduced to Mr Ruskin's method; he must study for himself the extended details, for which there is not space herein. They are luminous; they revive the forgotten strength of olden time, and bid the student dare to be thoughtful and self-reliant in his vocation.

Sometimes the thought crosses us in reading Ruskin that he really does not know the extent of unity existing in one generation with his aims and teaching. His popularity ought to be sufficient expression to encourage him, but it does not. Apparently isolate, he discourses abstractly, when he really might take most of us into his confidence. In his sixth lecture on Design, he tells us that his hearers are aware that the assertion that art should be didactic receives clamorous and violent derision from countless artists who have nothing to represent, and from writers who have nothing to say; and that art is by them believed to consist in pretty colours and fine words; and that all this is "accepted readily enough by a public which rarely pauses to look at a picture with attention, or read a sentence with understanding." Now, this is a caricature which ought to be rebuked. We all feel with Mr Ruskin that advancing art must have a didactic purpose. Devoted as the age is to mechanical science, because of the exigencies of modern life, and because of the grand revelations which have come to us in that and in the kindred region of natural philosophy, we do not think meanly of the artist who puts his *thoughts* at a venture upon canvas—quite the contrary; he is sure of his market. So of the engraver. Would we had more of them. The public deplores the sparsity of wood and metal engravers, and is weary with the inaninity of a multitude of mere cutters. It thirsts for and would recognise good work on the models Mr. Ruskin has depicted, and the public knows that the true workers will come, because God never makes us sensible of a want without having previously provided for its satisfaction.

The vindication of the Technics of Metal Engraving is a most redeeming chapter; in it much honour and just praise is placed to the account of the engraver. Steel is an ugly thing to draw upon, especially when the workman has to do 3000 lines to the square inch! You cannot slur, you cannot efface, you cannot play with it. You must feel what you are doing, and know precisely what to do. Suppose you took a sheet of paper, and tried to do that graver's work with the finest of pens. Take your glass and count the dots and lines innumerable in some of those heads, and then, says the justly scornful teacher, "I humbly ask you to try and do it yourself, or a piece of it. You clever sketcher—you young lady or gentleman of genius—you eye-glass dilettante—you current writer of criticism—I beseech you, do it yourself; do the mere etched outline yourself, if no more. Look you—you hold your etching needle this way, as you would a pencil nearly, and then—you scratch with it! It is as easy as lying. . . . Or, take foliage, pass your lens over them—outline, leaf, distant rock, hollows of that rock, thicket, towers—count the lines in a laurel bush, arch, or casement: 150 or 200 deliberately drawn, all skilfully put into its place! and consider what the ordinary sketcher's work must appear to the men who have been trained to this."

These are brave words; they are just words. We have some acquaintance with the toil of such life and the imitations perpetrated. They contain a rebuke of wider application than even to the toil of the engraver, and should check the assumption of those who dare to judge without knowledge.

We have only space to notice his current work Fors Clavigera and to close our brief notice—all too brief.

Fors Clavigera is a practical book. It touches the conduct of all "Workmen and Labourers" instructively. Perhaps we ought in this magazine to regard only construction and invention, for that is what people generally call practical matters, always remembering that the world is very fond of attaching the name practical to those also who make the most wealth out of circumstance, without inquiring into the methods that have been adopted. Mr. Ruskin's ideas, we will take the liberty of summarizing with this qualification, that, however they may clash with the accepted notions he always gives a rational justification for

[1] Ariadne Florentina, p. 2

his belief. Addressing "Workmen and Labourers" in these seventy-five monthly numbers, he expounds the first principles. "1. To do your own work well, whether it be for life or death; 2. To help other people at theirs, when you can, and seek to avenge no injury; 3. To be sure you can obey good laws before you seek to alter bad ones." He explains the title of this great work inculcating Deed, Patience, and Law. "The first object of all work—not the principal one—is to get food, clothes, lodging, and fuel. All wages mean the food and lodging given you by the possessors of the land—the squires." "Know the functions of those who you are taught to think of as your protectors against the squires;—your employers, viz., capitalists, employers is a noble title, but why not employ—yourselves. Teachers of Political Economy lack theories inapplicable under worldly conditions, in which he demolishes Mr. Mill's especially. Workmen say that any thing that brings work does good, but they are always reducing the hours of work; they might make it sixteen if they like, but they make it nine. "It is pay you want, not work." There are, practically, two absolutely opposite kinds of labour going on among men for ever. 1. Labour supported by capital, producing nothing; 2. Labour unsupported by capital, producing all things. There are other kinds, and well paid labour can be productive, but these are the extremes in actual life. The largest means are spent in mischief, and the most useful work is ill-paid.

Mr. Ruskin has a hatred of trade competition, "Freemen, indeed! You are slaves..... Though in the year 1102 it was decreed at St. Peter's, Westminster, that no man in the future should carry on the wicked trade of selling men in the markets like brute beasts..... the no less wicked trade of *under* selling men in markets has lasted to this day, producing conditions of slavery, differing from the ancient ones only, in being starved, instead of being full-fed. In all former slaveries the slave's complaint has been of compulsory *work*. But the modern Politico-Economic Slave is a new and far more injured species condemned to Compulsory *Idleness*, for fear he should spoil other people's trade. The national theory is—if you are a shoemaker, it is a law of Heaven that you must sell your goods under their price in order to destroy the trade of other shoemakers."

"Of all attainable liberties be sure first to strive to be useful. Independence you had better cease to talk of, for you are dependent not only on every act of people you have never heard of, who are living round you, but on every past act of what has been dust for a thousand years."

"Knowledge by itself will not make you happy, still less will it make you rich. . . . I told you last month 'science did not pay.' But you don't know what science is. You fancy it means mechanical art; and so you have put a statue of science on the Holborn viaduct, with a steam-engine regulator in its hands. My ingenious friends, science has no more to do with making steam-engines than with making breeches. . . . Science lives in quiet places, and with odd people, mostly poor."

Very fierce were Mr. Ruskin's opinions on river pollution; but, as modern care has found in part means of using the foul water as a waste product, and is daily increasing that knowledge, we can afford to wait a little while and ascertain the exact success which has followed more recent experience.

But our observations must be brought to an end. The later volumes of this series of letters to the workmen and labourers wear rather a cynical aspect, and it would seem that, to some extent, disappointment has clouded the kindliness of his nature. No man has done more hard work, or spent in proportion more liberally his money for the elevation of the industry of England to self-respect and honour. Hundreds will ever bear toward him great affection, and if his sentiments and convictions are not shared so much as he would have them among the classes who produce and who govern, it is impossible to deny the vitality of those principles, and of course the possibility of their ultimate supremacy. He cannot be studied in vain. All his teaching is essentially practical. It has to do with life: whether the glorious remnants of forgotten generations, or the economics of the present are under discussion, the same great intellect stored with riches all might envy, and, in some respects none else possess, scatters gems of thought, knowledge, suggestion, and hope, cheering to the weary, informing to the ignorant, and enlightening to all.

We hear that he has now engaged in organising a series of visits to celebrated places in the company of intelligent workers when he will discourse as *chaperone* on what has been and is.

At the age of 51, Mr. Ruskin commenced the series of his works which he deems worth preserving and has published them in his own manner, which manner should be described because they are not to be obtained through a bookseller. At least we have never seen them except at his bookbinders, Haydon and Mansell in Little Queen Street, Holborn. He long ago resolved that the price marked on his books should be exactly what he received and no more, and if any body chose to buy through the bookseller they should pay a commission. Of course the trade turned away, and his books are sold by his Manager, Mr. Allen, Orpington, Kent.

The 1st vol. is "Sesame and Lilies;" 2nd, "Six Essays on Political Economy or Memera Palveris;" the 3rd, "Six Lectures on Sculpture;" the 4th, the lectures on Engraving already noticed: the 5th, "Time and Tide by Weare and Tyne;" twenty-five letters to a working man of Sunderland on the laws of work; the 6th, the "Crown of Wild Olive" above noticed;—the remainder are in progress. They form an intellectual contribution to our English literature of the most valuable order. The style is strong, and all the contents have been revised and in several cases the matter has been amplified.

The facts of his life are chiefly in his literary productions.—All know him as one of the founders of the Working Man's College, where he attended to teach, himself, the working men in the art class. We know him as philanthropist in many forms; and latterly as an experimenter in a scheme at Oxford in which he has been aided by students. A princely fortune has been spent, and he is still a wonderful example among a generation that sadly lacks individuality. Oxford is proud of him as Slade Professor; and Englishmen are there who in all future times will hold his name and character in reverence and affection.

W. S. C.

THE INDUSTRIES OF CANADA.

CANADA and Great Britain are alike gratified by their mutual relation. The one has been able to supply from her numerous family a generation who are not ashamed of their original, and it is the more pleasant that the progeny is as full of usefulness and willingness to remember the duties of relationship as the other is glad to recognise the spirit of independence that ought to be respected because of the absence of impertinence. Canada is the Scotland of the Western Hemisphere, and the great St. Laurence the Cheviot Hills. It will remain independent as a dominion: it will grow as a Dominion; its race is Anglo-Saxon and French, which combines in the unity the strength and polish of Europe. The spirit of revolution, having found there no rest for the sole of its foot, departed, and the spirit of loyalty remains intact; because Canada is worthy: and Britain is glad to see her claim the honourable position of semi-independent relationship.

In any discourse upon the productiveness of a partly undeveloped district or dominion we have the advantage of judging from what is, when endeavouring to forecast what is to be. The sorrows of a thousand years have not been necessary to educate her into the self-possession of the mother country; but the heritage of the glorious result is hers without the sorrow. Canada has had the days of darkness, and they have not been few. General Wolfe and Sir Allen M'Nab knew well that the course of nations is no lawn play; but by comparison the dominion has won a proud position at an easier price than any other section of the universe. Let us put aside all political matters, and prove by its present condition from one hundred years only of life that it is the most wonderful progress ever made in this world.

In our memory the idea of mechanical industry in Canada would have been rejected with contempt, the colony and the home government only desiring the immigration of labourers with a little capital, and some carpenters and smiths. The land, the land, was all the cry. Settlers, and settlers only, should undertake to clear it and make it their own upon easy terms. There was no conception of the idea, that a vast deal more than surface composed the forests of their new residence. True, there were towns and villages, but these needed no immigrants. Out of themselves sufficient town folk would arise to execute all the orders for goods which the squatter could not produce at home. It is a contrast now. Canada contains, in metals and their ores, Magnetic Iron Ore, Specular Iron Ore, Sumonite (Bog Ore) Fitaniferous Iron, Sulphuret of Zinc, Sulphuret of Lead, Copper, Nickel, Silver, and Gold. In Non-metallic Minerals there are Uranium, Chromium, Cobalt, Manganese, Iron Pyrites, Graphite, Dolomite, Carbonate of Magnesia, Sulphate of Baryta, Iron Ochres, Steatite, Lithographic Stone, Agates, Jasper, Labrador, Felspar, Aventurine, Hyacinthe, Corumdum, Amethyst, Jet, Quartzose Sandstone, Retinite and Basalt, Gypsum, Shell Marl, Phosphate of Lime, Millstones, Grindstones, Whetstones, and Tripoli. Of building materials, it has Granites, Sandstone, Limestones various; Roofing Slates and Flagging Stones; besides Clays, suitable for red bricks, tiles, pottery and white bricks; and also Marbles, white, black, red, brown, yellow, and black, grey

and variegated and green. Finally, combustibles, viz., Peat, Petroleum and Asphaltum.

Now the gradual discovery of all these riches could not but tend to create a desire to use them as well as to sell them, and there has arisen in that land a large class of manufacturers, engineers, and inventors, who find profitable occupation in the pursuits of science. These derived their instruction from foreign sources at first, and many able men still go there from this country as engineers, chemists, and the like. So recently as 1871 this circumstance gave rise to a strong remonstrance from friends of education, who desired less classical and more technical matters in the general curriculum. "In the practical fields, are our classical schools turning out the men the country has need of—the scientific agriculturist, the horticulturist, the surveyor, the civil engineer, the mineralogist, the architect, the builder, the designer, the chemist, the machinist, the mechanic, or any of the practical producers or manufacturers which bring wealth to the land? Are not these of our imports, and will not these have ever to be sought for *abroad*, while the arts and scientific education have no place in the schools of the country?" Can one imagine a greater contrast in the public sentiment having occurred within fifty years. The writer is somewhat rhetorical and exaggerates, for Canada was helping herself to knowledge, and the subsequent six years form a period of extraordinary progression.

Those who witnessed the Great Exhibition of 1851 will call to mind the favourable impression produced by a survey of the Canadian section. Hops, wheat, peas, and all sorts of corn and seeds, potatoes, sugar, and other fruits, were associated with cheeses, barrels of pork, agricultural implements, canoes, harness leather, and, to conclude the list, forges, models of locomotives, and also of a bridge, a rifle or two, a fiddle, a steam engine, a fire engine, and the fish oils. That was only twenty-six years ago: the bulk of articles were of the agricultural description both in products or machinery, and the machinery could be counted on the fingers of one hand; but what has the twenty-six years done for them, and what have the people done with their time? Their political unity is one of the most remarkable phenomena in statesmanship, and their growth in the industrial and mechanical arts is equally honourable and grand.

In 1856 Mr. J. C. Taché, of Toronto, in his official capacity speaking as fervently as truth would allow, describes the whole range of manufacturing industry in Canada as consisting of shipbuilding, of which, says he, "I may be excused a little national pride when I state the fact, that a ship of 1600 tons built at Quebec beat a rival by seven days in a journey to Australia." Then they manufactured also furniture, carriages, implements, chiefly of wood, and other articles of wood, pearlash, and saw mills. The treatment of leather, especially of the porpoise and whale, is of well-known excellence; and he places much emphasis on the oil-refining from the blubber of fishes. Finally, he informed the government that they had linen and woollen factories for their natural productions, and among their artificial productions "all sorts of machinery, tools, leather, paper, printing type, musical instruments, and indeed workshops for every art or profession." The Great Exhibition did more good to Canada than to any other country. It took the lesson as affectionately as a dutiful child would acquire knowledge, and in a few years industrial arts and the application of machinery spread over all the land. The towns and the farms vied with each other in the work of reducing the hard labour of man, and elevating all to a range of higher intellectual position and of augmented happiness.

Let us see what is the present aspect of Canadian industrial art.

Many alarmists have argued that because the imports to Canada exceed the exports in value, Canada itself was obliged to depend as in old days upon the supply of machinery and other industrial products from foreign countries, and that when she could export most, the influx of gold balances would be so much profit. It is fallacious. Canada does not and never did seek an export trade. The surplus must go somewhere, and because of that necessity she does export. The magnificent forests she would be thankful if any nation would clear away, but it is troublesome and unrenumerative, considering the risk, to export as a commercial speculation. Timber should be ordered. On the other hand, a very large proportion of the imports are for convertible purposes: either materials for making machines or for making up miscellaneous articles such as civilisation as well as necessity require. The imports will actually be doubled in value before consumed, and the difference goes to augment the wealth of the Dominion. Iron rails to make railways, and coal for many uses not only are converted into a new value, but if employed in constructing public works, are the foundation of a permanent income that has no debit.

Very remarkable is the jealous rivalry that exists between the United States and Canada. The latter confidently assert that they can turn out all their manufactures cheaper and better than any other people in the world *except Europe*, and to a great extent the remark is just. The Canadian will have quality in what he buys, and is justly proud of his workmanship in that it is honest and upon good materials. It is a characteristic that would rejoice Mr. Carlyle, whose opinion on trading and mechanical morality is not of the most flattering description. Even in the iron manufacture the Canadian is able to dare comparison with his southern cousin.

To begin with the youngest—the Porcelain and Pottery. The enterprising Canadian manufacturers have only recently commenced their operations in this department, but their specimens of what is known as "granite," and C C (cream-coloured) ware are very respectable, of good quality in compactness of body, with a glaze well incorporated, and of fair hardness. The success attained is the more remarkable as the manufacture of these wares, so important for household use, has not been long established. Various glazed earthenwares, stoneware, fire and other bricks, chimney pots, and even terra cotta, are among their productions. The moulding is less perfect than others, but a new manufacture must have its period of growth. In filters, jars, drain pipes, and in terra-cotta a profitable business is carried on. The manufacturers carefully examine all the specimens from other countries with a view to perfect their own, and of course are rapidly improving both in style and finish. Most of all, they must learn by their intimacy with Great Britain how to imitate us in stoneware particularly; solidity of body, extreme hardness, fineness of glaze, and accuracy of moulding, make our goods the most perfect of any in the world; and Canada will be certain to grow in skill, knowledge, and reputation. Great efforts are being made towards setting up Canadian manfactories for producing woollen goods. The native wool occupies a first-class place in the market, and the pastures yield a rapidly increasing quantity of the best kinds, such as the Merino, Southdown, Lincoln, Leicester, and Cotswold wools, that command the highest "values."

There are now a great number of working establishments in Canada which are employed respectively in turning out edge tools, such as are used by carpenters and joiners, and hand tools of every kind; also cutlery works for knives and scissors, and factories for castings and hollow-ware, several other metallic products, and safes. We must not omit to mention specially the great firm which has done more than any other in enhancing the quality and reputation of the Dominion as a manufacturing people—Messrs R. H. Smith and Co., St Catherine, Ontario. They excel in the large circulars employed in machinery, and in cast-steel saws, frame saws, hand and tenon saws, and a variety of the smaller sizes of carpenters' tools. They are said to use Jessop's steel, but the quality is excellent, and the workmanship confessedly superior. Another firm has a pre-eminence in the manufacture of steel hay forks, manure spuds, hoes, and garden tools of excellent quality and workmanship, and extremely light,—namely the house of Messrs A. S. Whetting, Manufacturing Company, of Ottawa, Ontario. Nor, as names are mentioned, should the house of Messrs Pellow, Hersey, and Company of Montreal, who employ a large number of skilled first-class workmen in the production of every variety of nail and spike be omitted. Lastly, in this part of our subject, Canada makes her own Mercantile Safes. Mr. Godefroy Chaplean, of Montreal, is the maker, and although the variety or the structure does not compare with Milner or Chubb at home, they are approved sufficiently to secure the house full occupation.

It is with more than satisfaction that we review the Canadian progress in Machines and Tools for working Metal, Wood, and Stone. The new country astonishes every observer in this respect; none excel her in the extent and excellence of the machinery to produce and the goods supplied. She has given herself resolutely to engineering; and, although the youngest of the competing nations, furnishes admirable specimens of a quality and style quite equal to the market demand.

Canadian machinery has a character of its own; theory has not gone before practice as in many cases, because her engineering knowledge and experience have not reached the foundry and smithy through the technological college or the class room, but rather through the teachings and promptings of necessity, and from contact with Great Britain and Continental centres. Hence has come a style peculiar to Canada; a good style, but different from our own, while a combination of English and American; the tools for working iron resembling the English models, and those for treating wood are essentially of American origin, but in both cases are originality in style and thought apparent. Canada does not copy; it adapts. The freshness and youthful vigour in design and in execution are apparent, and they foretell a future which will do honour to the mother country and the offspring.

In motors Canada is strong, both in respect of water and steam, and in machine tools she respectably rivals the home productions. One firm in particular, M'Kechnie & Bertram, of Dunday, have acquired a great fame in metal and wood tools, and coming from Canada it has taken all by surprise. Perhaps the most perfect is a large slotting machine of fine proportions and of consistent detail; but the most conspicuous happened, in the opinion of some observers in this factory, to be a drilling machine of versatile capabilities, very beautiful in its structure and perfect in its arrangement, but as a triumph of mechanism it does not excel the slotting machine.

Moulding machines, screw-cutting, and side lathes that will bear the test of comparison anywhere for design, materials, and workmanship, testify to the progessive tendency of Canadian practical work.

And that term Practical is the key to all of Canadian success. As we have seen, they possess the riches of the universe in regard of material, and they also have a great deal more than an incipient idea of the methods for utilisation.

The portable saw-machinery of the Waterous Engine Works Company is convenient in its arrangement and remarkable for the facility with which it can be removed to some other place. Especially does Canada deserve honour for the manufacture of circular saws. The quality is all that can be desired, and the severest tests are always invited by the makers. Whether they could bear the comparison with Sheffield is exceedingly doubtful, but the defiance shows a spirit of emulation that commands respect, and will not excite any jealousy. Sheffield has had the crown in the face of the world for two hundred years, and it cannot be taken away; still, if a young nation, an offspring, desires to excel, let her try; we shall be equally pleased whoever may win in the struggle for supremacy in art and trade.

We will now breifly survey the industrial power of Canada in regard of invention.

On the continent there are perpetually new circumstances, and labour is dear because it is scarce. Hence the multiplicity of inventions. Great Britain is prolific in the field, and a vast number must be reckoned among those which are of no consequence, being either repetitions or of no value. Canada had no patents until 1842, while the mother country dates from the time of King James I. Born out of time, and as the cynic might say out of circumstance, she had not a chance to tell the story of her children's life; and if the reader will be respectful in listening to that story, it would seem proper to give to the daughter of the west some credit for the work and for the intellectual instinct that has been exemplified by the costly patents the Canadians have rightfully established.

Take for instance;—Mr. Riley in 1842 claims to possess an improved method of brewing ale, beer, porter, and other malt liquors, and Mr Alexander a patent for improving stoves cast in Scotland. These had to wait a year before being passed, and we may be sure were pretty well tested; but they passed five-and-thirty years ago. Then came rivalries about water wheels, drilling pumps, rotary steam engines, fire engines, washing machines, stove making, and distilling. This is pretty well for a start; but if we go further we shall see that the dull snow-bound country not only has the life, but can express the life; and not only express the life, but knows how to vindicate that life.

That Patent Laws are necessary is evident from the experience of Canada. Nothing more firmly establishes the general confidence in any given policy like experience. Canada began her Patent Laws in 1842. In that year eight patents were taken out: in the following year 13; in the next 11; in 1845, 21; in 1846, 39. The people were not eager; they waited to see its working, and to give opportunity for testing the inventive faculties of the community. But in 1869 the number rose to 582, and this clearly shows the mechanical progress of the Dominion and the growth of knowledge. It also proves the capacity for government which a people possesses who are able to contrive mechanical means for overcoming natural difficulties peculiar to their own soil or circumstances. One cannot read the abstract of these inventions without being struck with this remarkable trait;—inventions of not the slightest use here, inventions which here would never have been invented, because no cause existed for their service.

We will review a few of these, or rather name them. Mr. M'Laren patents a stump extractor: Mr. Mills improves on wooden bridges: Mr. Paradee has a new method of constructing rakes for making hay and grain, called the improved revolving joint-tooth spring lever horse-rake; Mr. Tyler provides superior bee-hives and also a snow extracter for clearing rails; and a "spark arrester and extinguisher:" but not to mention names we have an apparatus for raising all kinds of nets or other instruments used in taking porpoises and other species of fish: horse-threshing machines; house pump or fire engine; new churns; new ways of making mill stones; portable grist mills; brick-making machines, and several others. But we are struck with the gradual expansion of mechanical power as shown in the patent roll. The first few years were, as we have seen, almost exclusively patents relating to agriculture and domestic economy; but as time went on there arose necessities not so easily satisfied, and we got from the want of coal a new method of propelling vessels, carriages, &c., by machinery without the aid of fuel: and in the broad shallow waters there arose necessity for a new description of paddle wheels, called sweeping paddle wheels, for propelling steam and other vessels; and even as far back as 1845 there was an invention of a new and improved steam engine.

It is of interest to watch this growth of mechanical art, as seen in the inventive genius of the Canadian people; all of it is of direct local application, and may be practically divided into two classes, domestic and manufacturing, with this little exception that all along the road you meet with novelties in connection with distilling. We suppose that no Chancellor of the Exchequer, or Chief of Excise interfered with people who brewed their own whisky, for unless the manufacture were free it could never have paid a man to take out patents for improvements in distillation of which there are very many: he must have a domestic market to which he could appeal. Stills for distilling and rectifying abound, if that can be called abundance when few patents were taken; but contrivances for agricultural use are still more abundant. They include ploughs, horse shoes, chaff cutters, pumps; new and improved machines for cutting hay and straw; new tiles for buildings: new chaff-cutting boxes; improvements in grinding corn into meal; improvements in drilling implements; new construction of waggons combining springs and coupling; threshing machines and rakes came in for a share of honours that ought to give a fortune to the young people of our time if the ideas were worth anything; and so we might talk and quote to a great length. It is in our purpose to note the gradual departure from the more domestic and the agricultural, and watch the variety of invention belonging to another gauge and another service.

In carpentry, which at that time happened to be one of the chief virtues of a man emigrant, one patents a better way of grooving; another, a better way of running the perpendicular saw; another cuts staves with unprecedented rapidity and correctness; another, a rabbeted complete air-and-water-tight joint; another, new ways of planing, tonguing, and grooving boards; machines for sawing straight and crooked wood of equal and unequal dimensions; new apparatus for dessicating timber or other materials; machines that would saw and plane; combinations of machinery for cask-making that we fear did not forshadow Ransome; machines for working irregular surfaces into a regular shape; and so on. These indicate an advance from the merely agricultural to the mechanical; and from that we advance to machinery and to the æsthetics of manufacture. The lines cannot be strictly drawn because they are amazingly mixed. The carpenter joins with the farmer, and the artizan is necessary for them both. Still we find that as the years go on the insignificant inventions belonging to agriculture and carpentry fade away into insignificancy before the galaxy of endeavour belonging to machinery, and of that we will do our best to describe.

Nevertheless, sometimes the ideas were ludicrous, as when one takes out a patent for a mode by which power is to be derived from the wheel, and the screw may be applied to any kind of machinery, as if it were possible to create a monopoly in reference to such mechanical powers as wheels and screws; another devised a new method of raising fruit trees from the parent tree without grafting or budding; another prospected his new and useful improvement in the slab plate pillar and column usually placed at graves in memory of the dead.

The improvements connected with the steam engine are few, as also those appertaining to railway matters. One improves the cars and carriages: others have new methods of preventing cars from leaving the metals; make improvements in the carriages; improves the ventilation of the cars; but none of these are for new designs, or do they contain any evidence of invention.

Of singular patents or inventions we should have scarcely thought worth the trouble of protecting, there are many, such as a fruit preserver, a steam washer, a reversible gate, a reversible gridiron, a bag holder, a gate hinge, a milk cooler, coffee pots, whips, mop pails, lock bolts, a bean harvester, a groat separator, cork preserver, a self-acting whiffle tree snap, imperial clothes pin, rapid climber, a milking stool, expansion horse shoes, and the like. Mary Taylor has a method of manufacturing cheese from sour milk; David Ellis makes a composition for the destruction of the Canadian thistle; indeed the facilities for taking out patents of five years are so great as to give the list a comical aspect, double cylinder chimney pots, easy chairs, sewing machines,

turnip pullers, horse forks, safety trucks, improved stair steps, pumpsuckers, fruit driers, potatoe parers, new materials for the making of paper, a hundred sorts of churns, grates, with here and there machines of more importance. The patents are for the most part protective of small and cheap productions, ingenious and useful, but not indicative of great mechanical genius. They belong to the common occupations of the people, and are in great variety.

The Dominion of Canada has a neighbour in Nova Scotia, whose patent law is older, but who does not shine conspicuously either in number or quality. One patents a method of preventing chimneys from smoking, another an instrument for drawing teeth, another blows blacksmiths' bellows by water power; another, a machine for making butter; another for pianofortes; an agriculturist patents his method of digging potatoes. We see fish ladders, laths, skates, freezing apparatus, lamps, paper making, saw sharpener, washing machines, ship windlasses, amalgamators many, cooking stoves, facilitators, distillitators, and many unintelligible inventions that seem to be trivial, but none of the type we recognise here as true discoveries It is not the subjugation of nature to the service of man which is the essence of inventive study, but the adaptation by various contrivances of common ideas, and deriving therefrom small monopolies for trading purposes.

We notice, however, a sound telegraph in 1855 and several improvements of telegraphic instruments, but carpet stretchers, bed fasteners, advertising frames, traps, lamps, knitting machines, wooden pavements, facilitating the lacing of boots, and every form of agricultural implements, occupy the inventive faculty of the people of Nova Scotia and New Brunswick just the same as it does in Canada. Canada has a future in another field which should be noticed. Iron clads are filling our docks and rivers, and the construction of wooden ships is rapidly declining; but there are not wanting evidence that the fashion may change or be considerably modified. If that should be the case we may look for a rival of wooden ships from Canada, for that country has the best resources of any in the world: wooden ships have advantages that are not appreciated, and probably the general plan will ultimately be the composite of iron and wood.

The patents of the country show that the attention of the enterprising population has been attracted to this important prospect. Ship-building has not been very successfully carried on there. The timber is of the very best, and fifty years does not produce decay, but the building has not been worthy of the material; now that the education of the community has changed and a much higher range of knowledge attained, we may expect to see the revival and continual progression of that form of mechanical skill. W. S. C.

FIRE-PLACES, AND HOW TO MAKE THEM GOOD.

ENGLAND is proud of the fire-side. The inspiration of war is always to be produced by an appeal to the hearths and homes of England. The man who leaves in the early morning with a scant breakfast and goes through a day of work, desires no greater reward than to come to his own dear fireside. It is his rest. It is not worth much commercially; it is of priceless value to him. War and peace look to the fireside as their only reunion. The solace of the merchant, the labourer, and the engineer, is dependent on the chance of getting to the fireside. It is his goal: it is his rest.

But what a rest! Fancy yourself in an area of 40 feet square, and the only chance in a winter's night of a cheerful warmth, dependent on a seat in the chimney corner that only held about eight; and where were you? Cold, blasting winds, awful draughts, coming from everywhere, rushed in to feed a huge cargo of fuel that hospitably tried to do good, but in practice did great harm. The one side of a man was hot and the other wasn't. We love the old story of England: we have known it ourselves: it is good to say in all honesty that the dear loveable romance is better among the past than the present.

Human comfort in winter time cannot be promoted or produced by snug chimney corners; there is too much draught, and also too much waste. The old social idea of life is exploded in regard of warming arrangements; there was no sociality, for nobody was warm. People under certain circumstances may fancy they are, but they are not! A huge fire-place is simply a delusion—a waste—a misery—a fraud.

Loving as we do modern invention, it is due to ourselves to say that the ancients had the same idea. They did not find the centre fire beneficial: it made one side hot and the other cold. And when chimneys were invented they found the advantage of getting rid of the smoke, bur they did not find an increased warmth: in fact they were better off with the old centre fire and no chimney than with the corner. The draughts came from everywhere in the primeval condition, but by the chimney those drafts were concentrated on the corner, and thereby came screens;—the most outrageous interference in a household that the genius of evil could devise.

For what have we to do with screens? The atmosphere is what we have to measure and regulate. Who wants to hide behind a snuggery? Home life desires freedom and intercourse. God has given us the methods of control by which we can adapt his etherial and mundane laws to the benefit of our species, and to the comfort of ourselves in the poor seventy years he has allotted to man.

Last month we were discoursing on the economy of fuel, and it is a question which comes to the heart of a manufacturer's establishment in an Englishman's home. How to use wood; how to use coal; how to combine; are problems of sufficient tiresomeness. But where are we to put the material? Bonfires are out of fashion, and when in fashion were not good enough for every day. We want to secure domestic comfort; we want to obtain what our fathers were denied; we desire the highest comfort at the smallest expense. But pray take care that in this request we do not want anything good that we will not pay for at a righteous value. The economy of fuel is a national and an individual question. The blind sportiveness of olden days is departed, but the spirit is not. The necessity which intrudes upon every household exists, and it is to that we will address ourselves. The speculative tendency of our times extinguished the blind sportiveness which derided all improvement, and out of all sportiveness there has come a strength and power that cannot be resisted.

But among all economics nothing is so fine as that which could economise to a minimum the smoke. We left off fires in the hall, and had awfully big chimneys, but they smoked; and we were worse off than ever. The bacon might enjoy and benefit by the interference of an unknown condition, but the householder did not. He fretted. The subject is universal, but in the *Times* Mr. Godolphin Osborne offered good advice worth reprinting with abridgment. "Let him now try my receipt, choosing the very coldest room in his house. Take out the present grate, and clear away all the space under the chimney. Call any intelligent working mason who should require four of the large fire-brick slabs, 16 in. by 14 in. Set one of these on the floor of the space cleared away, so that it shall stand directly under where the fire-box of the former grate was, projecting it four inches into the hearthstone, cut away for the purpose. This is for the base of the fire. One of the said fire-brick slabs is now to be put upright for the back of the fire, not more than five inches from the front, not including the piece of the base slab let into the hearthstone. The two other slabs are now put upright for the sides, leaving the front of this three-sided box—16 in. high by 14 in. broad—in the clear. Suppose this backed up by brick and the chief mason's work is done, with these exceptions—the back of the fire-brick box should slope from four inches at the base to five and a half inches at the top. And he will put in the iron front.

"I give the cheapest way of going to work. Call in a smith; let him make an iron hurdle to fit in the front of the box. This is done by two iron pegs projecting from the outer side of the hurdles—at 3 in. from the top, and bottom. The mason will drill holes to take those pegs, so that the iron front shall be firmly fixed when all the work is made good. Where the back slab is to be joined to the chimney it should be sloped towards it by using a few of the ordinary sized common fire-bricks. The sides of the fire-box being built up, an iron bar should go across at the same height from the top rail of the iron hurdle the said rail is from the ground; on this the mason will build to fill up all the space above.

"The general prospect from the room will be a chimney-piece with square wall of brick down to the floor, with just space enough open in the centre to show some straight iron bars, forming the front of a square grate 16 in. by 14 in., with a depth from front to back 4 in. at the base, 5½ in. at the top, with the space between the grate and chimney. It is not thus far ornamental, nor is it expensive. I have four in work, which cost, labour and all, about £1, 4s. each.

"Light the fire (it must indeed be a very bad chimney if it smokes), you will find it draw well, and very soon you will have a frontage of red-hot coal, with very little blaze after the first quarter of an hour. As there is no space between the bottom of the grate and the floor, you will have no draught to chill your feet and blow the heat up the chimney. If, instead of pokering it up, you will now and then poke it straight between the bars, you will never complain of want of heat: you will have exchanged a rounded or oval trough of coals, showing a few hot

coals between great heavy bars, with a large mass of black on the top, the only heat of any importance being under it acting as a blast, for a quiet, steady, burning mass of cheerful red coals smiling on you between the iron hurdle bars from top to bottom, the fire-bricks throwing out great heat.

"If you study the ornamental you may front your grate, or rather the sides and top, with slate or coloured tiles. Instead of a mere iron hurdle, you may have the bars twisted into some pleasing form, let into an ornamental framework, so as to take in and out when wanted; this is all mere matter of detail.

"I and many of my friends have had many years' experience of these grates, and have never found them fail, if fairly proportioned to the size of the room. Of course the mason must take care that all woodwork is properly protected. There can be no doubt as to the heat given, and I am satisfied that there is a great saving of fuel. With some I have lately had fixed I have had a space left outside the sides and back, with openings at the base of the brickwork on each side of the front.

"*P.S.*—The dimensions I have given would warm, I am satisfied, the best drawing-room of any ordinary-sized parson's house. I can speak for the success of the plan, tried in a very cold room in an episcopal palace, in the rooms of two friends whose position in life gave them libraries of no small dimensions, whose expensive grates were a perpetual source of chilling irritation, who, I am sure, have gained in peace of mind and cost of coals."

This produced a smart reply, which strengthened the case. Mr. Mechi of Tiptree Hall desired to know who had taught him in order that he might express his thanks, and says—

"As the plan, as described by him, necessitates the removal of the previous stoves, I found that the ladies objected to part with their ornamental registers; so I, at last, compromised the matter, by adapting the plan to these stoves (without disturbing either them or the hearthstones), at the small cost of less than 20s., as stated at foot. I have no hesitation in asserting that this plan will not only cure smoky chimneys, and thus render unnecessary chimney pots, and the various ugly contrivances which disfigure our house-tops, but it very greatly increases the warmth and comfort of our rooms, which is really the great desideratum. No railway station should be without them. It is also admirably adapted for frying, boiling, roasting, and toasting. A solitary bachelor, having a Dutch oven, would consider it the *ne plus ultra;* our pet cat, that used to sit on chairs to avoid the current of cold air, which passed along the floor to enter under the grate of ordinary stoves, and blew the heat up the chimney, now luxuriates on the carpet; and our feet and legs are first to feel the heat. Persons with humble means would especially benefit by this plan.

"To prevent trouble and correspondence, I have deposited a full-size model, with printed information, at my place of business, 112 Regent Street, for public inspection. The grate may be described as a long, deep, but narrow trough, with fire-brick ends, back, and floor. The front is an iron hurdle, having from 8 to 10 bars of round iron 7-16ths of an inch thick, with intervals of 1¼ inches. A trough 16 inches deep and 14 inches wide, would heat a full-sized room, containing 450 superficial feet. The interior of the grate is only 4½ inches from back to front at its base, and 5½ inches at the level of the top bar. This thin stratum of coal permits the air, which enters only through the front bars, to circulate freely between the coals, and thus causes perfect combustion.

"Except when fitted to previous register stoves, the floor of the grate is level with the floor of the room; when applied to existing stoves, the trough is fitted into the grate.

"In adapting them to present grates, I find fire bricks more suitable than fire lumps, as they can be cut to shapes.

"Particular attention should be paid to the opening above the grate into the chimney. It should not be larger than in an ordinary register stove—say about 20 to 30 inches superficial, and near to the back wall.

"The appearance of the fire after lighting is a display of gas jets, which gradually pass into red-hot coke, the surrounding fire-bricks also becoming red-hot. A new layer of coals on the top also, in turn, becomes gas jets and coke, so that only a small portion of smoke is wasted, and the chimney is much less fouled than by the flat, broad, ordinary fire.

"Unlike the ordinary grates, the heat is diffused in the room, instead of being wasted up the chimney.

"When fresh coals are heaped on the top we have still the bright broad fire below, the red-hot bricks being occasionally visible. A small, light poker, twenty inches long, and of quarter-inch round iron, is all-sufficient. My smith charged me 1s. 9d. for three of them. A very little stirring converts the coal into coke.

"Old folks like myself (for I am in my 75th year) need no longer go south for warmth, for in their own rooms they can now enjoy an almost tropical temperature, free from draught and with free perspiration. Warm, Turkish, and vapour baths will be at a discount.

The cost is as follows:—

My country blacksmith charges for iron hurdles 14 in. by 12 in., with eight 7-16 in. round iron bars . . .	£0 5 0
16 in. by 14 in., nine bars . .	0 7 0
Pokers, 7d. each.	

London prices would, no doubt, be higher.

"Bricklayer, £1, 14s. for setting four stoves, including fire-bricks, labour, &c.

"I prefer to slope the sides to the back diagonally.

"It is imperative that whatever may be the length or depth of the fire-trough, it must not be more than 4½ inches from back to front at its base, and 5½ inches at the level of the top bar. The floor of the trough must be of fire-brick, and not of grating. The fire-bars should be of wrought-iron, round, and not more than 7-16ths of an inch in diameter—the space between them 1¼ inch—to prevent the coals falling out. In the large, lofty entrance halls of mansions, where wood is burned, the fire-trough may be somewhat wider from back to front, as air could circulate more freely than with coal. Where the hurdle is long (say 6 feet), there should be a stiff upright to each 2 feet length of fire-bars.

"A fire on this principle, 4 feet long and 2 feet deep, would warm an immense hall. For cooking, the trivets hanging from the third or fourth bar should project far enough to receive saucepans and kettles, for they will boil as well in front of the fire as on the top, the joints roasting between them.

"A well made-up fire in a bedroom would last far into the night.

"The reason why this form of grate cures all smoky chimneys is, that it converts so much of the coal smoke into flaming gas, that an irresistible current of heated air forces its way up the chimney. I know, from practical experience, that the flame from a single gas-burner will, in a short time, cause an up-current in the most obstinate smoky chimney.

"It is desirable that the fire-bricks should form a ledge 2½ inches wide at back and sides of the trough level with the front bar, to support kettles or saucepans, or even spare coals ready for putting on.

"If the chimney has a large opening, a moveable piece of sheet-iron can be placed in it at a trifling cost.

"In labourers' cottages a fire-grate complete, built in the wall, would only cost 12s.—say 5s. for the hurdle, 14 by 12—and the bricklayer, 7s. An ornamental paper border might surround it, or the wall.

"When the fire is well made up, the common dust or screenings of coal may be heaped on, and will soon cake and become flame and coke. This is important, because for every 100 tons of coal raised from the pit, there are 40 tons of slack or dust. This is not only a loss to the coal owner, but a nuisance and a danger. I can, therefore, purchase this in truck-loads at my station at Kelvedon at 12s. per ton, and always use it for my steam-engine.

"I hope that my friends and the public will receive this communication as my new year's gift.—J. J. MECHI."

The venerable J. J. Mechi, Esq. of Kelvedon, in the zeal with which he regards every beneficial novelty, writes to the *Times* the results of his experiences in this business:—

"Some time ago your correspondent, 'Another Country Parson,' suggested a reform in fire-grates, and gave details of his experience. I have adopted his suggestion with very great comfort to myself and family, and think his system worthy of general use. Although very different from the fire-grate portion of ordinary stoves, it does not necessitate any alteration in the stove itself, so far as regards outward ornamentation. I have referred to 'Wye Williams on Combustion,' and 'Dr Ure on Heating Apartments,' and find that their theories of perfect combustion are consistent with your correspondent's system, which is that air should not rush rapidly through the fire from beneath the grate, but that it should only pass in freely, but gradually, between the front bars, which are only half-an-inch thick and 1¼ inch from bar to bar. The fire rests on fire-brick, level with the floor, and is enclosed in a trough (with fire brick sides and back) 16 inches deep and 14 inches wide, 4½ inches from back to front at bottom, and 5½ inches at top. We have thus a thin vertical fire, in which the air can circulate freely, presenting a frontage of fire 16 inches by 14 inches. I should be happy to forward printed details to any gentleman requiring them."

He received the following letter from Colonel Feilding the next day:—

"107 QUEEN'S GATE, LONDON.

"SIR,—With reference to your letter in to-dav's *Times* I write to say that some three or four years ago I noticed in that paper the letter about Grates, signed 'Another Country Parson,' I had three grates made at my country house, in Wilts, exactly in accordance with the instructions, and found them so *excellent in every way*, that I wrote to Mr. Delane, begging him to republish the Parson's letter in the *Times*. Mr. Delane, however, wrote me a note in reply to say it was contrary to the rules of the *Times* to republish anything that had appeared in its columns. I have since had similar grates put into the Hospital of the Coldstream Guards, of which I am Colonel, and my object in troubling you with this note is simply to say that if any of your friends in London would wish to see the grates, they can do so at any time by going to the Coldstream Guards' Hospital, in Vincent Square, as I have instructed the Steward to show them to any one mentioning your name. Messrs. Barnard, Bishop, & Barnards, of Norwich, construct grates on exactly the same principles, and I have just put twenty of them into this house. Pray do not think it necessary to acknowledge this unless you have leisure, just to let me know for what sum you have been able to put up the Parson's grates, as I have found it impossible here or in Wilts to get them for anything like the sum mentioned by the Parson."

And that elicited a further letter from S. G. O. :—

"SIR,—As the writer some time ago in your columns on the subject of 'Grates,' under the signature now alluded to, 'Another Parson,' perhaps you will kindly permit me to add this further notice of the subject. If I recollect right, 'A Parson' had written in your columns complaining of the little heat for large expenditure of coals he obtained from the ordinary grate; I wrote to give him the reason why, and gave him the directions for the front fire-grate Mr. Mechi now so zealously and wisely recommends.

"I have been the means of introducing them very widely, and, with very rare exceptions, most successfully. I have had them in use for more than twenty-five years. I believe not less than forty of them are in use in houses where I now live. I have instructed the tradesmen on the spot how to make and 'set' them.

"As Mr. Mechi supplies printed particulars from which any smith may make them, and his specifications seem to be the same I gave in your columns, I need say nothing on that head. As to the expense, this depends on the amount of ornament; simply constructed they are very cheap. I, a few weeks since, sent one down to a son's parsonage in Lincolnshire, completely fitted in every detail, very neat in appearance—the whole front, fire-bricks, and grate, cost £2, 8s. If you choose to have them set with ornamental tiles, &c., of course you can go to any expense. I am writing now before one which cost me £1, 10s., but then it is of the plainest construction, certainly not ornamental. In my part of the country and elsewhere I have been credited with their invention. The principle on which they were originally constructed I first had from a London tradesman, who recommended it to a friend then building a large house. I got an ingenious smith to undertake their manufacture, with some improvements in the details which I suggested. He made, and for all I know may now make, a large number, sending his own men to fix them. After all, the plan is founded on the simplest of all principles—to get as much radiation of heat into the room as possible, to let as little heat escape up the chimney. The base of the front bar rests level with the floor of the room, backed by fire-brick, and floored with it, this floor projecting into the hearthstone; deep from the top bar to the bottom, but shallow from front to back; there is no draught under the coals to drive the heat up the chimney, the action of the air in the room is direct on the whole front; if the bars are kept narrow you have thus a large amount of red heat always directed roomwards, only black coal on the top of the grate. I have five going in my own house, and can say, in all truth, I believe I get more heat at an expenditure of less coals than I could from any seven of the old construction.—THE WRITER OF 'ANOTHER PARSON'S LETTER."'

(The Rev. Lord S. G. Osborne, "S.G.O.")

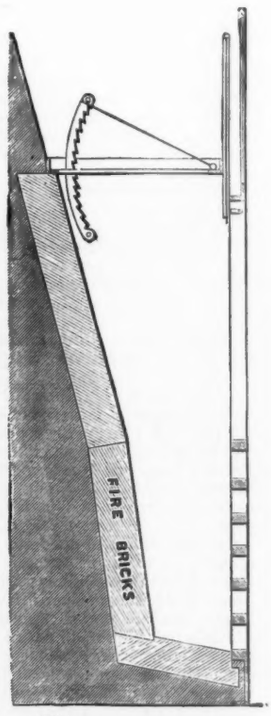


Fig. 1.

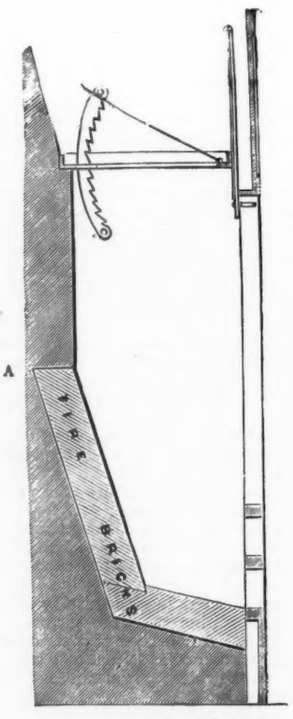


Fig. 2.

To give an idea of the construction, the section above is inserted. This is the one preferred by the house who have made it their sole business to construct the Grates or Stoves demanded by modern skill and usage. (Fig. 1.)

The Fire bricks supplied specially extend to the angle A after which common Fire bricks are used. The shape is likely to give out greater heat than that described by the well known writer of another county, Parson's letter. (Fig. 2.) The scale is 1½ inch to the foot.

The economy effected is produced at the most trifling outlay. A Stove, with Register Door and Frame, Fire bricks and Cramps is supplied for about thirty shillings, and those who desire the

Fig. 3.

elegance of Brass and Polished Steel can have the widest description for ten guineas—a little extra charge is made for the blower, when that addition is desired.

But the varieties now being constructed must tend to the general adoption of the novelty. In **Fig. 4.** is illustrated one that is 3 feet wide, and of the height of 3 feet, with a 14 inch

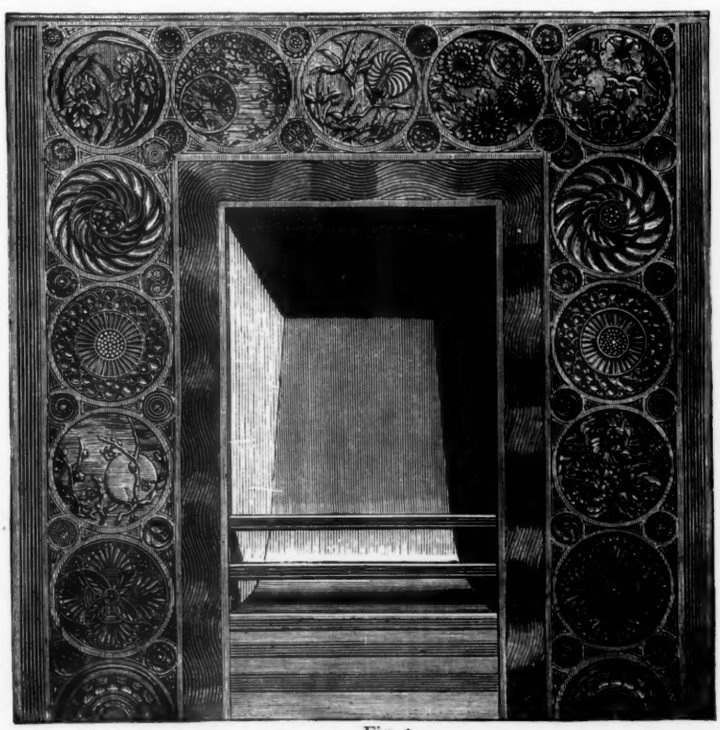


Fig. 4

fire-bar. These cost from four pounds to twenty-five; and can be fitted as an improved Registered Hot Air Stove, with fire-basket, ventilators, hot air chamber, and wrought-iron casing—requiring no bricklayer's fixing, and where space will permit all can be encased in a frame holding tiles for a border and of various designs.

We add an illustration of one still larger, and of a different pattern. This in block costs about four pounds, and in bronze five; or may be had in brass as those previously described, and in order to adapt them to existing fireplaces and mantel-pieces, a semi-circular ornamental head can be added.

The splayed side Stove fitted with blue or yellow hand-painted tiles is handsome, and is capable of being treated of course with any coloured tiles or any patterns. These, independent of tiles, are sold at prices ranging between three and fourteen pounds.

Our space will only allow of two more illustrations. The one

Fig. 7.

of the ashes pan, and the other the pattern as advocated by Mr. Mechi, and "Another Country Parson"—these are also in great variety, but do not quite equal the later-made improvements we have described.

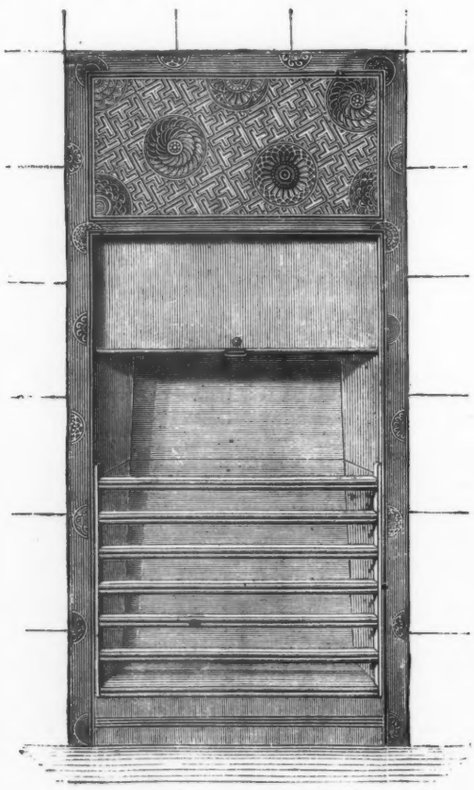


Fig. 8

The subject of fire-places is engaging more than ever the attention of architects and house-owners, and we have been led to offer the above notice of Messrs Barnard, Bishop, and Barnard's Stoves, from the remarks of Mr. Harcourt in his Cantor Lecture, which appeared in the last number of this journal, and highly commended the labours of the Norwich Engineers. There is another, and an important branch of manufacture, which will form the subject of a second article, namely, the utility of close fire-places for cooking and for heating the entire atmosphere of a house in reference to which these have a very large number of contrivances, inventions and patents.

We Englishmen hate close fire-places, but we abominate cold. Is it not better that from the hall, at a small cost, all the house shall be up to 60°? Of that we will hereafter speak

NEEDLES AND PINS.

HAVING traced the course of invention concerning Needles we may proceed to the same treatment about Pins. Pins are of the utmost utility, and have called forth human ingenuity to a great extent. We know they are made of wire, generally brass, and that in their manufacture there are fourteen operations after the wire is placed in the factory, duly prepared.

These operations are as follows:—Wire drawing is of course done upon cylinders, and as these cylinders are filled the metal is

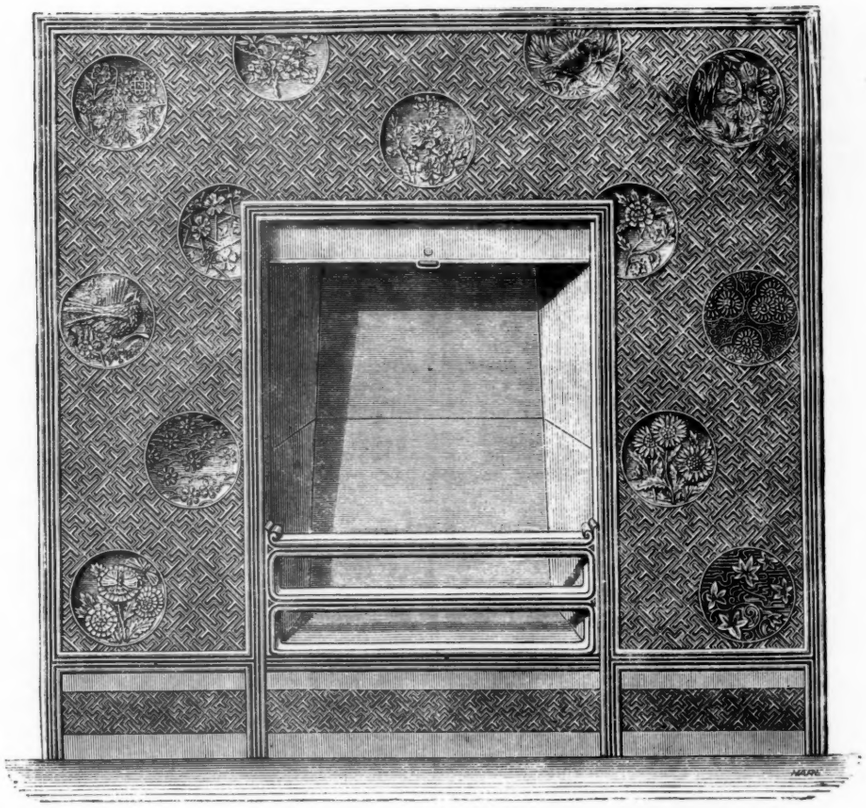


Fig. 5.

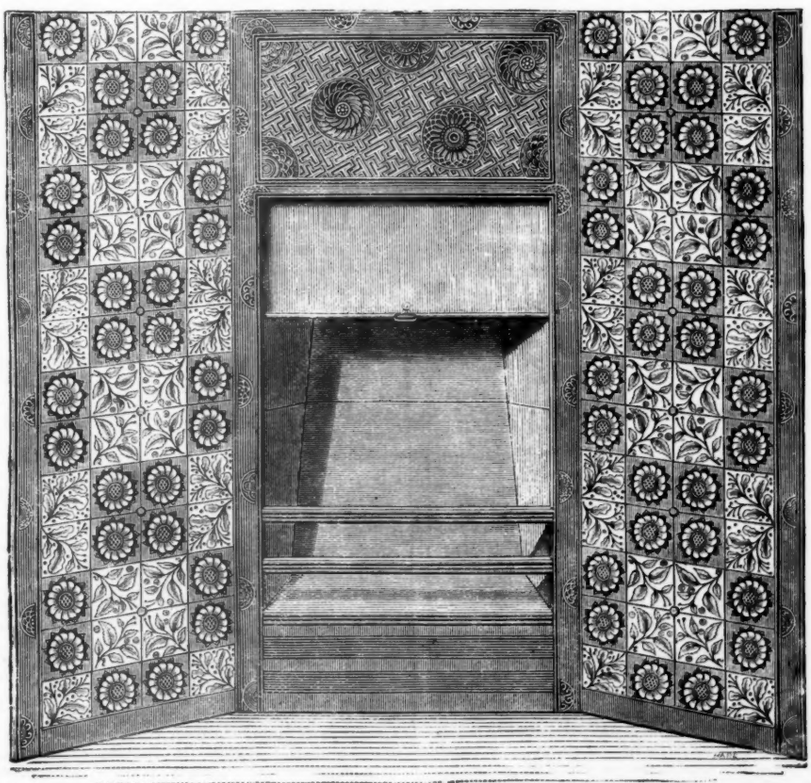


Fig. 6.

curved. It has to be made perfectly straight at a bench. Pieces of wire about 30 feet in length are cut off, and by the aid of pincers made straight. It is then cut up into lengths of three pins with great rapidity; a good workman will cut 18 or 20,000 dozen of these lengths in a day. Then the pointing is done upon revolving wheels, the circumference of which is cut with teeth, one fine, the other coarse. Thirty or forty of these lengths are packed up at once, and pointed by the revolution of the wheels. Then the head-wire is twisted, and another cuts the heads, another anneals them; another shapes them by stamping; another boils and washes; and another whitens or tins them; the eleventh dries and polishes; the twelfth prepares the paper, and the last papers them ready for sale. It is said that this is one of the most marvellous instances of successful division of labour; 12,000 articles passing through fourteen separate stages are, with the material supplied, sold for three shillings.

The earliest improvement dates 1797, and that was for heading them with spun iron wire heads, or by casting on heads of metal, which latter he effected by placing the shafts in a row in a mould, and running in a mixture of lead and antimony. The pins were then immersed in sulphuric acid and washed; then scoured, then coated, and finally whitened and rinsed and dried in bran. As soon as machinery becomes of service in the production of goods, pins received the honour of inventors' care.

Grooved dies, hoppers in the pin shafts for heading were successful from 1809 and 1812 to 1817, when a pin making machine by Seth Hunt appeared. In 1824 the straightening machine was introduced. "The pins are made directly from wire carried on a reel attached to the machine, and passed through the heads as before only by mechanical means. This machine contained all the other work and improved that work. It had its cutting nippers, carriers, revolving wheels, dies for shaping and for fastening the heads, and a contrivance at the end to expel the finished pin. Several others followed, but that by Mr. Wright is supposed to be the best; which had better be described in the patentee's own words."

"The rotation of a principal shaft mounted with several cams, gives motion to various sliders, levers, and wheels, which work the different parts. A slider pushes pincers forwards, which draws wire from a reel at every rotation of the shaft, and advance such a length of wire as will produce one pin. A die cuts off the said length of wire by the descent of its upper chap; the chap then opens a carrier, which takes the pin to the pointing apparatus. Here it is received by a holder which turns round, while a bevel-edges file-wheel rapidly revolves, and tapers the end of the wire to a point. The pin is now conducted by a second carrier to a finer file-wheel, in order to finish the point by a second grinding. A third carrier then transfers the pin to the first heading die, and by the advance of a steel-punch the end of the pin wire is forced into a recess, whereby the head is partially swelled out. A fourth carrier removes the pin to a second die, where the heading is perfected. When the heading-bar retires, a forked lever draws the finished pin from the die, and drops it into a receptacle below."

Gradual attempts to improve the pointing followed, and also contrivances for obviating the defects of coating the metal, but very little real or important change seems to have been made, except what have arisen from the obvious lessons of experience. Lemuel Wright's machine, made more than fifty years ago, is a marvel of ingenuity, as is seen by its being still the main principle.

THE METROPOLITAN FIRE BRIGADE.

PROBABLY there is no English institution which contributes half the quantity of useful information on public matters than is derived from a Select Committee of the House of Commons. It obtains an authorisation, works without any interruption from obstructions, and in about three months makes up its report; which report is accepted as the basis of legislation, though not the guide thereto. From its evidence and opinions the Parliament is able to discern the way through darkness and confusion to a better because less interrupted future.

Almost all men of intelligence are more or less public men. The influence of one upon another is like electricity. All questions are public ones. Even diplomacy must be content to lose its mask; and while it may be urged that we have too many cooks, we find practically that good work is done, abuses terminated, and improvements enforced, by the common attraction, which draws men of all degrees into the vortex of public affairs, or into the control of local arrangements and politics.

Fire is an ever present peril, especially to large towns: we know not where it will end when once begun, and nation after nation, in even the primal groupings of civilisation, have been experimenting and improving with the hope of reducing to a minimum the risk from fire. What has been done in London that contains information or suggestion for the provinces must receive the acceptance of the mass of Englishmen, especially those of wealth, whose interests are involved inextricably by country and town.

The London brigade was established, January 1866, on the basis of the old London fire-engine establishment, a voluntary institution supported by the insurance companies and the general public at a cost of £25,000 a year, and engines provided by the parishes, &c. Like all voluntary obligations, some people felt them, and some did not, and the enormous augmentation of wealth and territory compelled the legislature to intervene by new legislation. Captain Shaw had instructions to scheme. His first at £70,000 had summary dismissal; his second at £50,000 received its quietus for the same reason, and a ½d. rate—or £50,000, was all that the ministry could go to Parliament about. The capital of £40,000 for engines and the like is not counted: for that the brigade might have borrowing powers under the Metropolitan Board of Works. In the ten years subsequent these borrowing powers have reached an indebtedness for station-houses, fire-engines, fire-escapes, and permanent plant alone of £130,000. Current expenses are provided for in the yearly taxation. In fact these borrowing powers have now run up to £190,000, and are not yet exhausted. Captain Shaw is absolute master in the control and disposal of the force, only that the brigade must be recruited exclusively from sailors of the royal navy and merchant service. This unfettered discretion has enhanced the board's efficiency.

The brigade was constituted on the assumption that fire extinction depended on it independently of the police, but that contract is found to be a foolish one. Without any cost the police and police stations could be utilised, and by placing hydrants at all the police stations much injury may be prevented as the business and area is increased. As it is, our brigade stations are a mile apart, and the police not half a one. Again, in all places where river traffic prevails the land defence against fire is regulated, and no steam launches and rafts provided. These are costly, but what of that compared with the burning of a wharf or bonded warehouse? There has been no telegraphic communication between the police stations and the brigade, except one with Scotland Yard, and the other to Shooter's Hill. And the force is not half manned, the officers being obliged in extremity to lend a hand when they should be engaged in superintendence. And it would be a serious calamity to have two demands at one station in a single night. The labour is exhausting, many hours at a stretch, and has broken many of the men down. His rest is shockingly irregular, and his life unnecessarily hard. Captain Shaw must many times have been weary of his life with the rejection of almost every humane and rational proposal he has made.

First, as to improvements. The present condition is very hard, and entails confusion. There is no ill feeling between the police and the brigade, but the duties, instead of being co-operative, are not. In fact some proposals have been made that the forces should be united, only of course with differing primary duties, but able to help each other in an emergency. No doubt that would bring a superior class of men into both services. There are two chief defects. The interval between conflagration or danger to human life can be checked, is perilous, for neither brigade, turncocks, or fire-escapes are there; and second, there is no reserve in the event of a double conflagration occurring at one time. Just when minutes are beyond all price valuable, they are thrown away by stupid regulations. The police ought to be that reserve.

Then, on the supply of water. It is bad enough that the constant supply to ordinary customers should be denied, but for extinguishing fire it is a wicked and unjustifiable neglect. With a constant supply a fireman, without waiting for a turncock, could obtain water immediately from any pipe; but now he must send for the turncock, and wait his arrival, while the fire passes beyond his control. Besides, the water companies lower their pressure when people go to bed, and factories are closed, and the pressure is inadequate. There must be special mains for public purposes to a much greater extent than already exists. Bits of pipes, about as big as a walking stick or one's wrist, are absurd as water conduits in extinguishing fire. Look at the plugs. Drawing it is easy enough. Most firemen know how, and have tools to do that: but where is the reservoir, and how can the water be stopped from running to waste? Sometimes a standpipe or dummy is used, but in every case there is a dreadful loss of water. Nothing can be more primitive or unsatisfactory. It is waste of water, and of power of delivery. It cannot utilize the force that may be in the mains. And the fireman

cannot use it until the engine has come, and the turn-cock likewise.

Hydrants vary very much in their construction: they may be roughly described as an appliance permanently attached to the water-carrying pipe, and give direct communication with the water by means of opening a stop-cock; and to admit of a hose being readily and securely screwed on when water is wanted, the hose is screwed on and the stop-cock opened: the water then flows at once into the engine or jet; and when enough water has been procured the stop-cock is shut, and the hose unscrewed without waste or delay.

But hydrants, as a system, cannot be relied on as a substitute for fire-engines without constant supply at high pressure concentrated at the point of delivery, and in pipes of sufficient diameter and in moderate distances. These provisions are met in provincial towns, such as Liverpool, Manchester, and Brighton, where the water-works are in the hands of the corporation, and arrangements are made, bringing the highest pressure to bear; and the police are employed in working the hydrants. In Manchester only three per cent of the fires need the engine at all. The Kent Water-works Company—the most satisfactorily worked of any of the London companies—have hydranted a good part of their district at a cost of £3, 6s. 11d. per hydrant, or £4, 15s. for some special ones at Woolwich and Greenwich.

The committee think that the water supply of the metropolis should pass into the hands of a single authority, and be placed under a statutory obligation to provide jets for fire extinctions; that water ought not to be a source of profit, but a public provision: and pending that, the separate action of water companies might be brought under control and consolidation.

We have thus abridged an important document, respecting which more will have to be said when treating of hydraulic machines in another part of our magazine.

ORDER, METHOD, AND CLEANLINESS IN FACTORIES AND WORKSHOPS.

BIRMINGHAM arrangements, and those existing in Lancashire and Yorkshire, about the subject of this paper, have been placed in rather sharp contrast by Mr. S. W. Richards, a gentleman who is a partner in a button manufacturing firm in the above town. He has had the opportunity of comparing workmen's homes in the textile districts of the north with those at home, and now as the result of his inquiry into the asserted difference, he alleges that the houses of the operatives of the northern counties are characterised by an air of cleanliness, freshness, and general comfort, that is wanting in Birmingham; and that this produces a different spirit among the peoples. He says,—

Houses are built in a superior manner as to domestic arrangements; architects and builders take more pains, and the effect of their care is the creation of cheerfulness in home life there. On the ground-floor is a living room and a back room for kitchen and washhouse fitted with open furnace and boiler; plenty of water is laid on, and ventilation is secured. The Yorkshire range in the living room has an open fire, boiler, oven, and a stove ornamentally formed. The ash-floor is always whitened and kept tidy, and that floor gives an attraction to the Yorkshire fireside not known at Birmingham. The bright hearthstone harmonises with the painted walls and the whitewashed ceiling in a way that paperhangings could not cause. These walls are cleansed with soap and flannel, and the ceilings are "done over" twice every year.

Mr. Richards alleges—and, really, we incline to accept his statements *cum grano salis*—that the home of the Birmingham operative is a single living room on the ground floor, in a court having no outlet and no second room—a cramped-up ridiculously small fire-grate, no boiler, a little oven on one side, 9 or 10 inches square, divided in two parts, the cheapest, commonest, and most useless design ever made; no kitchen, papered walls that hang for years dirty, harbouring vermin, and no whitewash for years together; no good supply of water, but a common pump for the court into which sewage can percolate, is the usual, and in most cases the only supply; a general wash-house, occupied in turns by arrangement, and then not available for any tenant one entire day.

Since the Act of Sir Robert Peel, in 1802 [*qy.*], and subsequent Acts of 1833 and 1844, controlling and regulating labour in factories, and determining the conditions upon which it shall be carried on in the interests of the physical growth and health of children, young persons, and females, it may be said these northern districts had enjoyed advantages during the period represented between the dates 1802 and 1867 that have not been permitted to operatives here.

The magnificent factories, with every appliance and contrivance that could be suggested by human ingenuity for securing the most favourable conditions upon which the gigantic industries could be carried on, have aroused and kept alive the desire of the factory *employés* for clean, convenient houses. To these causes I attribute their growth and development.

What has been the rule, method, or custom here? Most factories in Birmingham may be said to consist of a series of workshops that have grown from month to month and year to year, without symmetry or design; that the largest of them are, with few exceptions, agglomerations of shops, all shapes and sizes, forming irregular masses of buildings (very frequently a *congeries* of six or seven houses, communication with each other through two holes in the walls) with no principle observed, securing to the workers either proper light, ventilation, or cleanliness. All these important considerations have been ignored, so that, as a rule, places are built subject to no supervision, and, in consequence, are in direct contravention of the laws of health, and sometimes even of decency.

Systematic cleanliness in workrooms is a term almost unknown, perhaps, in not more than 10 per cent. of the various trades of Birmingham; and if a hundred workshops or manufactories were visited, I doubt whether, previous to the Factories Act Extension Act, 1867, more than 5 per cent. of them had been whitewashed in a decade, and since, from the relaxations embodied in that Act after the most persistent opposition by our Chamber of Commerce, and especially to the whitewashing clause, I doubt very much, up to the present time, whether whitewashing has been a general practice.

It is important to care for order and cleanliness, when it is remembered that in textile manufactories 800,000 females are employed. Our operatives present a less favourable appearance in home and dress—tawdry, not substantial, not what a Yorkshire lass would call wholesome or cleanly—and their contentment with a state of things that would not be tolerated in some parts of Lancashire and Yorkshire for twenty-four hours.

It is wearying to hear the working classes so continually rated for their shortcomings and preached to, whilst the class above, who have so many opportunities, and so many obligations to discharge, neglect both.

It has always appeared somewhat of a mockery to me that such efforts should be made by a community to erect hospitals to cure diseases, whilst so little is done by the same community to prevent them. Birmingham in every part of it is busily occupied in its thousand different trades daily, carelessly and thoughtlessly,—ay, in the majority of workshops and manufactories; preparing patients for the different hospitals and dispensaries by its utter neglect and failure to observe the common rules of cleanliness.

It seems a sweeping charge to make, that our principal manufacturers, who live in suburban villas, surrounded with most of the luxuries of modern life, should be content to drive into town to their different places of business, and remain content when they see their workpeople occupied in the most loathsome of workshops, so unwholesome that they would be indignant if they were asked to use such workshops and hovels as stabling for their horses. Their stables and carriage-houses, or even dog-kennels at their homes, are palaces compared with very many of their manufactories, and members of this Congress may, if they are so disposed, easily test it. Whilst they would be shown over the suburban establishment and have all the newest appliances explained to them, if they were anxious to penetrate the dirty hives that contain the sinful working bees, some plausible excuse would be offered for not gratifying their curiosity.

I once knew a wealthy Birmingham brassfounder who kept an expensive horse to ride backwards and forwards to his place of business; the horse was stabled at the manufactory during the day. The owner, observing the horse was frequently unwell when in town, sent for a veterinary surgeon to examine the stable, and see if he could discover the cause of the animal's illness. This the "vet." soon did. "See," said he to the brassfounder, "the fumes that pour out from the doors and windows of this casting shop, adjoining the stable, affect the horse's health; you must build him a stable in another part of the premises." This was done at once, the animal's health improved, but the brass-casters—who were only men, whose health was not considered, and whose lives were certainly not so valuable from his point of view as the life of a horse—worked on under the same unhealthy conditions as before, and those of them not killed off by the noxious fumes continue working without a thought being given to them.

Till we have better influences pervading the towns generally—and I am sorry to say Birmingham does not stand alone, all the towns surrounding Birmingham resemble us very much—till

we have an "ideal" of what cleanly life should be, whether the ideal be created by our better educated and larger employers of labour, or whether the municipality set up the standard—till then, much of the philanthropic work of the many philanthropic institutions in our midst is neutralised. The late George Dawson once said, "What a famous thing it would be for this country if we could have a national annual scrubbing day." A people lost in dirt are lost to much of their self-respect; lift them out of this dirt, and you elevate both man and woman in their own and general esteem. The elevating process is going on slowly. When women were prohibited from the degrading labour of working in coal mines, an immense advance was made in the home-life of the collier, and when they are prohibited from working on the pit banks, another great step will be taken forward.

To further restrict the employment of females in degrading labour, I believe to be the surest means of improving their condition, physically, socially and morally, the lady advocates for unrestricted employment of females notwithstanding.

Slow as all these changes are brought about, a change is coming over the habits of Birmingham industrial life; thanks to the unremitting efforts and untiring zeal, coupled with long experience, of Robert Baker, Esq., her Majesty's inspector of factories of that district.

When Birmingham trades were placed under the law in 1867, license, liberty, and irregularity were rampant in many of them; men, women, and children were employed how and when some employers chose to employ them, and under any conditions. Mr. Baker kindly, but firmly, told the irregulars that this state of things would have to be altered, peacefully if they chose, but altered nevertheless.

Mr. Richards then described the operation of their firm who employ 400 operatives, three-fourths being females. They have no Saint Monday, but have for many years had the Saturday half-holiday. They would not tolerate an idle Monday. All the floors are scoured with soap and hot water once a month, and the rooms are 150 feet in length. Every alternate month all the windows are cleaned, and at the end of the year there occurs an annual whitewashing. A thousand volumes are in the free library; a sick club that gives 2s. a-week for every penny a-week paid in, only no one is allowed to pay in more than 5d. per week. The club is optional. He declares that their people are now tidy, cleanly, and will put themselves to much labour to keep the place in order. Their operatives stay with them ten and fifteen years, and they have only been in business twenty years.

Finally, he complains that the corporation buildings are disgracefully bad, and that the most unwholesome room in the town is the lecture-hall of the institute. He urges employers to mingle with their people in annual festivals, and in general matters exhibit sympathy and fellowship, knowing that such influences are not thrown away upon them, but bring a good reward.

REPORT ON THE PROGRESS AND CONDITION OF THE ROYAL GARDENS AT KEW.

THE prevalence of coffee disease in coffee-producing districts, has been the subject of much anxiety among commercial men and scientists; and Sir Joseph Hooker's report on the inquiries and experiments made will be read with interest by our subscribers:—

"In my last report I stated that Dr. Thwaites, the director of the Botanic Gardens, Peradeniya, Ceylon, had drawn up a series of questions on this subject which have been addressed to the various coffee-growing countries and colonies. All the replies and information that are likely to be received in answer to this inquiry having now come to hand, I have thought it would be most useful to summarise the results in the present report as likely to give them the widest circulation.

"According to the replies no disease, or, at any rate none with the characteristic peculiarities of the *Hemileia* occurs in any of the following seats of coffee cultivation:—Angola, Bahia, Bermuda, Carthagena, Cayenne, Costa Rica, Grenada Gold Coast, Guiana (British), Jamaica, Java, Madeira, Mauritius, Nicaragua, Reunion, St. Helena, Sierra Leone, Trinidad.

"In the following places from which replies have been sent coffee is not grown:—Barbadoes, Buenos Ayres, Honduras (British), Leeward Island (except Dominica), St. Vincent, Surinam, Zanzibar. With respect to the remainder, the information received may be conveniently summed up under the following heads:—

"1. *Hemileia vastatrix* ('leaf blight') of Ceylon and Southern India and associated diseases.

"2. *Cemiostoma coffeellum* ('coffee fly') of the Antilles and Brazil and associated diseases.

"3. 'Borer.'

"4. 'Coffee bug.'

"5. 'Canker' and other vague diseases, attributable to climatic causes.

"The reports received bearing on these several heads are perhaps not as complete in information as might have been both expected and desired. In the light, however, of knowledge derived from other sources, they have proved to possess considerable interest. In some cases the statements have been of a very hypothetical nature, as to give one instance, where a South American reporter expresses the opinion that the Ceylon disease—the vegetable origin of which is unequivocally known—is 'propagated by myriads of diminutive insects.'

"I cannot refrain from calling particular attention to the fact that whereas in British Guiana coffee was once largely cultivated, especially in the county of Berbice, it is now 'imported.'

"1. *Hemileia vastatrix*.—The 'Leaf disease' is a source of quite recent origin. In May, 1869, a few coffee plants were noticed in Ceylon to be attacked by a fungus upon the leaves. In July following, two or three acres of coffee plants were found to show it. After this its progress was quite extraordinary, and in 1872 it was to be found in nearly all, if not all, the estates in the island. It also soon spread to Southern India, and though Java is at present free from it, I learn, while this report is in operation, that it has made its appearance in Sumatra. I have, however, found no satisfactory evidence of its existence in other parts of the world than the islands and countries contiguous to the Indian Ocean. I conclude, therefore, that it is at present a local or endemic parasite, which however, unless measures are taken to prevent the introduction of coffee plants from infected countries into others at present free from it, may be expected to spread eventually wherever coffee is cultivated. The fungus which is allied to the moulds, was first described by our distinguished English fungologist, the Rev. M. J. Berkeley, in the *Gardener's Chronicle* for 1869 (p. 1157, with a woodcut) and subsequently in the *Journal* of the Linnean Society) Botany, vol. xiv. p., 93, pl. 3, fig. 10). A short account also appeared in the *Quarterly Journal of Microscopical Science* (1873, pp. 79-81). It is probably indigenous to Ceylon, and has only assumed the proportions of a scourge because it has found the constitution of the coffee plant suited to it.

"The conditions under which economic plants are grown in large areas are of course extremely favourable for the rapid extension and development of parasitic plants and insects. When these have only native plants in small quantities to prey upon they pass unnoticed, and their appearance on a large scale is one of the penalties which man must expect to pay, for such an enormous disturbance of natural conditions as is implied in replacing a tropical forest, of the most varied and mixed vegetation, by a plantation of some single economic plant. In temperate countries exactly similar phenomena are exhibited, by the rapid spread of the potato fungus, the vine louse (*Phylloxera*), and the potato beetle from the western side of America, first to the eastern, and then, at any rate in the case of the two former and no doubt eventually in the case of the latter, to the Old World.

"Mr. Berkeley's examination of the *Hemileia* was made from dried coffee leaves transmitted to this country. A first essential is a more adequate study of the fungus than such specimens could afford, especially in all the details of its life history, from germination to fructification. Some progress in this latter task has been made by Dr. Thwaites, with the co-operation of the Rev. R. Abbay, Fellow of Wadham College, Oxford, who was attached to the Eclipse Expedition, and remained some time afterwards in Ceylon for the benefit of his health. Mr. Abbay's observations, though imperfect, are a first step toward a more accurate knowledge of the subject, and will, I hope, shortly be published.

"The *mycelium*, or vegetative part of the *Hemileia* penetrates the tissues of the leaves of the coffee plant, where it is out of the reach of any agent such as sulphur (whether applied in powder, as is so successfully done with hop mildew, or—as suggested by Mr. George Wall—by fumigation). Moreover, the detailed treatment of the trees in a large plantation by any remedy of the kind would be practically impossible. I fear that the 'leaf disease' is a trouble with which the planters for the future will have always to reckon. As with our own potato disease, they must rest their hopes on the likelihood of its proving intermittent, and bear, as best they may, the constant loss of a certain percentage in every year with occasionally the loss of an entire crop. At the same time, every precaution should be made to destroy all the infected leaves by burning, and even, when more certain knowledge is arrived at, to boldly sacrifice the foliage of trees

on the first symptoms of the malady, as to prevent the fungus ripening a fresh crop of spores.

"In Mysore another disease appears also to be rather prevalent, which is produced by a fungus distinct from the *Hemileia*. This is known as the 'leaf rot,' or Kole-roga. It has been described by Dr. M. C. Cooke under the name of *Pellicularia koleroga* (*Gardeners' Chronicle*, 1876, Feb. 12, p. 246; March 4, p. 308; Grevillea, 1876, vol. iv., pp. 116, 134, 135). From a report by Dr. Cooke, issued by the India-office, it appears that the *Pellicularia* 'makes its appearance about July, when the leaves of the trees affected by it get covered with a slimy gelatinous matter, and turning black drop off, the berries likewise rot and fall in clusters.' It is estimated that nearly one quarter of the crop each year is lost by this plague. The collection and burning of the dead leaves will in this case also have to be persevered with. As suggested by Dr. Cooke, the fungus being external in its growth, is likely to be materially checked by the application of sulphur.

"A somewhat similar disease to the *Pellicularia*, but described in too vague a manner to speak definitely upon, seems to have occurred in 1864 in Jamaica, the leaves of the coffee plants being covered with 'a white substance of a glutinous nature.'

"As I have stated in an earlier portion of this report, the Liberian coffee has not proved exempt from the attacks of the *Hemileia* in India and Ceylon. Mr. G. A. Cruwell, who has visited Liberia, believes that it is affected with the *Hemileia* in its native country. Specimens sent to Kew by him are pronounced by Mr. Berkeley not to be affected by the Ceylon leaf disease, but to owe their discolouration to some other cause.

"2. *Cemiostoma coffeellum*.—A disease has for many years been known to exist in the island of Dominica, and also to a large extent in Brazil. This was characterised by the appearance of large discoloured blotches upon the leaves leading eventually to their decay and fall, and so seriously impairing the health of the trees, that various theories, mostly of a purely *à priori* character, were started to explain the cause, but competent investigation has placed the true explanation beyond a shadow of a doubt. The leaves are destroyed by the larvæ of a minute but very prolific moth. They live between the two surfaces of the laves, and gradually consume the intermediate cellular tissues. The moth is, in fact, a member of the same genus as that which mines the leaves of the laburnum in our gardens. This insect is said to lessen the coffee crop in Brazil by at least one-fifth. The little pest has been found in the Antilles, island of Martinique, province of Rio Janeiro, and over the whole coffee region of Brazil. According to an enclosure in Mr. Acting Consul Austin's despatch to the Foreign-office, it is of comparatively recent introduction into Brazil :—'In 1854, or soon after, the Imperial Government, desirous of introducing several species of coffee amongst us, advantageously cultivated in other parts of the world, committed the error of importing plants instead of seeds, and thus we had here coffee trees grown in Ceylon, Martinique, Bourbon, &c., it being quite possible that in this manner the germ of the coffee disease imported.' This is also the opinion of Mr. B. Pickman Mann, who has reported in the most admirable manner upon the whole subject to the Brazilian Government, see *American Naturalist*, 1876, June and July. I may also call attention to a similar transference, from the Old to the New World, of the moth which injures the sugar cane, and which is referred to below. Those interested in the matter should procure and study Mr. Mann's report. The only plan of radically dealing with this pest is to destroy the injured leaves while the coffee-fly is still in the larval state. Mr. Mann remarks :—'If the leaves were picked at such a time as to take the greatest number of larvæ when they were about two weeks old, it would not be difficult to select them, as the size of the blotches would make them very noticeable. I find that the expense would be more than met by the next year's crop.'

"Mr. Consul Pauli has sent from Puerto Rico leaves which are affected with the *Cemiostoma* in its most characteristic manner. The disease appears to do little injury in this island, and no particular attention is paid to it.

"In Venezuela a disease occurs which is known by the name of Candelillo," and which is also, according to information supplied by Mr. R. T. C. Middleton, her Majesty's Minister at Caracas, identical with the 'mancha de hierro,' or 'iron-stain.' Dr. Ernst, however, believes them to be different, and attributes the latter to the *Cemiostoma*. The specimens forwarded to this country by Mr. Middleton of the iron-stain are, however, at once distinguishable from the ravages of the *Cemiostoma*. The leaves have been submitted to the Rev. M. J. Berkeley, who reports that they are affected by a minute fungus, a *Depazea*, for which he proposes the specific name of *maculosa*. It has fusiform spores, ·0008 in. long, and containing about seven nuclei. In Venezuela coffee appears to suffer little, comparatively speaking, from maladies of any kind.

"Mr. Bunch, her Majesty's Minister at Bogota, has forwarded some leaves affected with blotches apparently identical with those from Caracas. This is apparently a rare malady. He has accompanied these with the following description, drawn up by Senor Saenz, Professor of Botany in the University of Bogota :—"It consists of circular or elliptical blotches of an ochreish yellow colour, in which are to be observed hard knots in the centre, round which are formed concentric bands. These salient knots are to be easily distinguished on each side of the leaf, but on one side only are to be found small fungi of a yellow colour (orange), formed of a very delicate pedicule, crowned by a small sheaf of fibres, in which are abundance of oval corpuscles of a darker colour, approaching to green, and of ·003 of a millimetre in diameter."

"3. '*Borer*.'—In all tropical countries trees of all kinds are peculiarly liable to the ravages of various wood-eating beetles. Coffee is no exception, and the reports from various countries mention 'borers,' no doubt different in every case, with which the cultivator has to contend. They are peculiarly met with where the plantations are new clearings, and an important means of extirpating them is the systematic clearance of any decaying or other wood which they can use as a refuge.

"They are mentioned from the West Coast of Africa, Sierra Leone, Liberia, and Gold Coast, they are also occasionally troublesome in Jamaica. It is in S. India, however, that they work harm on the largest scale, and for an account of the *Xylotrechus quadrupes*, which is the 'borer' of that country, I must refer to Dr Bidie's report on its ravages, published in 1869.

"4. '*Coffee Bug*.'—While 'borers' attack the roots and stems of coffee trees in hot countries, various species of *Coccidæ* suck the juices of the young twigs and leaves. Under the names of 'blight,' 'bug,' and 'scale,' these are mentioned in the reports from Gold Coast, Hawaii, Madeira, and Trinidad. In the latter case they are noted as being accompanied (as is often the case when they attack the orange) by 'sooty-blight,' a fungus (*Capnodium*, sp.) which covers the leaves with a dark incrustation. The coffee bug of Ceylon (*Lecanium caffeæ*) was once a source of considerable injury to the coffee estates of that island. It is decribed in Emerson Tennent's Natural History of Ceylon, pp. 436-441. As in other countries, in the face of careful cultivation it appears to have ceased to give annoyance.

"5. 'Canker.'—Coffee, for some imperfectly-understood reason, has apparently failed to hold its ground in Natal. It is subject to a 'bark disease,' which is thus described by Mr. C. T. Saner :—'The first symptom of the disease is the withering of a small tertiary or secondary branch ; on further examination it will be found that the bark, under the primary branches, is decayed and blue-mouldy ; the blue mould extends downwards gradually over the whole stem, killing the tree in a few months. . . . . A tree once attacked never recovers. . . . . All soils and situations seem alike liable to the disease ; the trees seem about to begin to suffer when about six years old. The area of land under coffee has been already much reduced, the crop having already proved unremunerative ; the sugar-cane is gradually but surely supplanting the coffee tree.'

"Here, of course, the mould is the proximate cause of death, but the ultimate cause is evidently, from the fact of its appearing when the trees are at the age of six years, due to some unfavourable external condition. The opinion of experienced persons in the colony is so entirely at variance as to what these may be, that I am indisposed to express any myself. The collapse of coffee-growing is by some attributed to neglect of cultivation, by others to unsuitability of climate, and, last of all, to want of depth of subsoil, as shown by the small height attained by the native arboreous vegetation.

"In Jamaica, 'canker' is also spoken of as a source of constant loss of about one per cent. per annum of the coffee trees. Its effects increase with age, and are attributed to the roots penetrating to uncongenial soil. Local 'blights' also occur, which are attributed to sudden climatic changes.

"In Java, a fungus attacks the trunks, giving them 'a white appearance,' and produces death in all the parts above."

Several medicinal plants of acknowledged reputation have occupied considerable attention at Kew during the year, notably the Balsam of Copaiba plant, some seeds of the Para kind having been introduced and germinated freely. The product of this tree, which is described as growing to a height of 80 feet before branching, is known as *Copaiba blanca*, and is chiefly exported to France, where it fetches a higher price than any other kind. A single tree, if tapped at the proper season, is said to yield about 84 imperial pints of balsam. The tree is recommended for introduction to India. Unfortunately, but little is known as to its botanical characters ; it has however been described as *Copaifera multijuga* of the Balsam of Peru plant (*Myroxylon pereirae*), a tree, not of Peru as its name would indicate, but of Central America. It is satisfactory to know that the plants introduced into Ceylon in 1861 have not only grown well, but have produced seeds in such abundance that quantities have been

sent from Ceylon to Kew, from whence they have been distributed to various tropical colonies.

Ipecacuanha (*Cephaelis ipecacuanha*) a valuable medicinal product of the Brazilian forest, used largely as an emetic and in dysentery, has been introduced into India, and while Dr. King, of the Calcutta Botanic Gardens, reports that he fears this drug cannot be grown profitably so far north in India as Bengal, states that the secret of its successful propagation being now perfectly understood, any quantity of seeds can be sent out. The plant seems in India to be of very slow growth, and consequently the annual production of root is small; this however can be met by a greater extension of its cultivation, which is easily effected by ordinary cuttings, dividing the root, or pegging a leaf to the earth. A trial of the dried root of Indian growth has been made in Calcutta, and reported upon as being as efficacious as the best quality of ipecacuanha from South America.

Many other plants of economic value have occupied the attention of the Kew authorities during the past year. Notably, the African oil palm (*Elaeis guineensis*) has been proposed to be introduced into the Island of Labuan. The new tanning material, known as the Algarroba of Chili, which is the pods of *Balsamocarpon brevifolium*, said to be much more valuable even than Divi-Divi, has been sent to Adelaide, Brisbane, Melbourne, Bahamas, Barbadoes, Bermuda, Cape of Good Hope, Natal, Lahore, and Gunesh Khind, Bombay.

The castor-oil plant (*Ricinus communis*), which the governor of the Bahamas states grows in the island as a weed, but is not cultivated, nor the oil expressed, has received so much attention that a supply of seeds of the best kind was obtained from Calcutta and transmitted to the Bahamas. On this Governor Robinson reports as follows:—"The yield of this variety of the castor-oil plant is, we should say, fully three times greater than that commonly found amongst us, the heads and the beans themselves being very much larger than those produced by the native variety. As the East India plant can be cultivated quite as easily and readily as our own, and as it possesses such a marked superiority in the matter of yield, we hope to see it speedily and widely introduced into the colony, so as to supersede the indigenous kind altogether."

Under the head of "Gutta-percha" is discussed a product of very great importance and of large consumption, but about the botanical history of which, we are reminded literally, nothing is known. Many kinds of gutta-percha, each with a distinct trade name, doubtless of native origin, find their way into commerce. The importance of a proper investigation of the gutta-percha-producing plants is pointed out, as there is good reason to believe that their geographical distribution is limited, and the wholesale collection of the product and consequent exhaustion and destruction of the trees must follow, no steps being taken to replace them. A better knowledge of the plants, therefore, would lead to their conservation or protection.

The question of new and cheap materials for papermaking is also one of great and increasing importance, more especially as the supply of alfa (*Macrochloa tenacissima*) is increasing in price and decreasing in quantity. Amongst the plants which have been recommended for this purpose are the following:—Bamboo (the young shoots), baobab bark (*Adansonia digitata*), *Fimbristylis spadicea* from Vera Cruz, *Heliconia bihai* from Jamaica and Trinidad, *Lepidosperma gladiatum*, from Australia, *Phragmites communis*, a common British reed, but which has been imported from Majorca, and *Uniola virgata*, a Jamaica grass. The reports on the quality of these for papermaking are varied.

A sugar-cane, known as the "Elephant cane of Cochin China," has created some little interest amongst sugar planters, on account of the great height attained by the plant. In a good soil, in two years, it attains a height of 10 feet, and in five or six years runs up to from 16 to 30 feet. It seems, however, not to be a valuable variety for cultivation, and is grown mostly for chewing. It will be a matter of regret to all to learn that the sugar-canes, both in Demerara and Queensland, are suffering from attacks of disease, the first from the ravages of an insect and the latter apparently from that of a fungus.

The foregoing notes will give a fair idea of the valuable work done at Kew, in benefiting not only our own country, but also our colonies and our great Indian Empire.

FACTORIES AND WORKSHOPS.

PARLIAMENT has never done a better deed than in resolving to control the condition of that portion of the governed who are dependent on their handiwork for the necessities of life. Many now living remember the beginning of that interference and the fierce opposition with which it was met—an opposition which came most ungraciously from the source it did. It is not necessary to exclaim against forgotten offences, nor to praise parties political in regard of matters social. It was a bright day for workers and for masters when the intolerable tyrannies and intolerable arrogance, and intolerable sufferings of both, were taken in hand by means of legislation, and both compelled to a mutual obedience to principles neither ought to have violated, but both did.

This is not the place to enter upon general remarks to any extent, beyond what is necessary for the introduction of what is practical. The present representative of English authority in factory legislation is Alexander Redgrave, Esq., and his name is better known in some places than that of any minister of State. He has just issued his report—it is his forty-ninth—and even that circumstance adds value to his words, because a man who can do forty-nine of these documents, which touch the most sensitive of all our social relations in trade, must be one who has discretion, discernment, courage, and kindness—he has just issued his report, and the practical part of that we will extract in this paper.

Trade is confined to the absolute and bare wants of the day; there is no enterprise—on the contrary, there is an absence of confidence which makes it fluctuating, spasmodic, and unremunerative. A few years ago there arose a wild storm in manufactures that brought about a most dreadful result—over-production. Caution after caution, pronounced by men who ought to have been heard because of their independence and position, fell upon deaf ears. Everybody would extend his machinery, enlarge his works, on the plea that his trade charges would not be increased while his turn-out would; thinking that if everybody did so, values must fall and a general loss ensue, not only of money, but of position. This mania extended to the Continent. They, seeing the perfection of English machinery, set to work at the imitation, and followed the same course of over-production; and a struggle began between England and the Continent who should produce the most. Suicidal as such courses are, we know that human passion or ambition, either can lead mankind into such folly. Hence, "We find that in America, Belgium, France, and Germany, trade is no better than in this country; and we find that the goods manufactures in these countries come here, and are sold in competition with our own. It does not prove that foreign manufacturers can produce goods cheaper or better, ... but it does prove that either they are frightfully over-stocked, or forced to discover new outlets because old prices have failed." We are injured more than any, because all foreign nations place prohibitory duties on imports, while we open our markets to free competition. When this folly is ended, trade will revive and profits really increase.

In regulating the hours of labour, Parliament first insisted on the limit of 60 hours a-week for young persons and women, and to children 6½ hours per day; but Mr. Redgrave found that the average habit already fell below that quantity, and the Act was useless; but as the Bill gave power to the Secretary of State to amend or alter the hours at discretion, tables were prepared for the purpose of regulating according to circumstances. Mr. Redgrave found that overtime could not be abolished in such trades as printing, bookbinding, and others, and a concession became necessary in the interest of employers and employed. Among the occupations in which overwork did not prevail was brick-making, it being excepted in the Act of 1864. The work is a season-occupation out of doors, exposed to hindrances from bad weather, and in every sense intermittent; but in 1867 Parliament was compelled to interfere then, in order "to introduce regularity of work" under the Workshops Act, and successfully; regular hours became law, and the change "had a continuous and direct effect in ameliorating the condition of the people," and benefiting the employers.

Workshops have been improved to a surprising degree in regard of their sanitary condition. Larger cubic space, improved ventilation, and greatly changed arrangements, have been by persuasion, and sometimes by force, taking the place of the miserably defective, unhealthy, and destructive immoralities of the past. When a man is now intending to erect a new factory, he applies to his old enemy, the inspector, because there he finds his truest friend. But this position has not been won by chance; it has been fought for. Filthy and poisonous arrangements have had to be stopped by sheer force, and the conquered have afterwards been thankful for the coercion. The Bill now before Parliament to consolidate these laws, proposes to extend the powers of inspectors, so far as not only decent arrangements shall be compelled, but periodical whitewashing be ordered at the inspector's discretion. Employers have, from being law-defying, become law-abiding, and now want to know how much space is proper for a human being to occupy, as its Maker has ordained. Mr. Redgrave replied, 250, and then we see another difficulty arise. Practical matters compel us to resent all the evasions familiar to fraudulent humanity. You

can build a place so high as to give 18 inches space for each person, and 250 cubic feet also, and you would kill them quicker than in the old stuffy rooms, because the foul air they exhale being heavy, cannot only not get away, but it is condensed by the confined purer air above into a poisonous atmosphere, ultimately oppressive. The work of the inspectors is to regulate these arrangements in the interest of all parties. We are sorry to say that the conduct of the workers is the direct trouble. They will not be obedient. They will have their own way. If their way happened to be a reasonable, rational way, every one would wish them good luck; but when their way is simply absurd, destructive, and silly, there is no alternative but to bring them under the hand of a law that will, as all laws should, enforce either obedience or destruction. And, mind you, it is not of working artizans alone these words are written. In our best offices under Government, among men who have a lot of money and little work comparatively, whether as regards quantity or capacity, the rebellious spirit has been manifest. Clerks of the works, managers, and persons who ought to know better, have brought about a trouble which, but for their example, would never have been initiated. We remember the howl which occurred a few months ago, which, on examination, was found to be the howlers' fault. They complained of foulness, and they had made it.

Reviewing ten years, Mr. Redgrave's assistant—Mr. Henderson—desires to let England know the result as to the practical working of the Factory Acts, and their influence on the industrial occupations of London. He says the application of the law is easy. He proves it.

"'You have come to ruin us,' was the greeting which I received from one of the largest manufacturers of artificial flowers, when I called upon him after the passing of the Act of 1867, and informed him that there was to be no work allowed after 8 P.M. 'Our business is too fanciful and too fluctuating to stand such an arbitrary law, and you will certainly destroy the trade in this country.' I did my best to reassure him, and to urge that probably the difficulties he apprehended would disappear, if manfully faced. At all events, there is the law, it is my duty to enforce it. What was the result? A year afterwards he acknowledged to me that the Factory Act had proved a blessing; he now got as much work in 10½ hours as he had formerly got in 12 or 14, and in one season had effected a saving of 30s. on his gas bill.

"The industrial history of the metropolis during the last few years is a marvellous story of rapid progress and development. I do not for a moment seek to attribute this to the influence of the Factory Acts; but I may perhaps be excused for pointing out that these Acts in their relation to trade have so far proved a decided success, that they have clearly not stood in the way of its successful growth and increase. This was not the expectation of very many of those engaged in London manufactures. Now I hardly know of a single manufacturing industry which has not grown and increased enormously during the past decade, and notwithstanding the introduction of a vast variety of labour-saving machinery, the number of persons employed has increased very largely, and a substantial addition has been made to the rate of wages, and especially to the wages paid to those classes who come under the protection of the Factory Acts—namely, women, young persons, and children.

"With regard to the reduction of pauperism, allowance has undoubtedly to be made for increased efficiency in administration, but no amount of efficiency could have effected the results had it not been aided and assisted by the rapid extension in the demand for labour, and the important rise in the rate of wages during the last five or six years. The general introduction of labour-saving machinery has proved one of the most important aids, and the most important of these labour-saving machines is the sewing-machine. By the aid of this most ingenious and useful instrument, it has become practicable to make of the dense population of London a great manufacturing community. Situated as it is, the high price of fuel is an effectual barrier to the use of steam as a motive power, and the surplus labour of London could never be utilised with profit in any branch of manufacture where such a power was necessary on a large scale. But the sewing-machine gives all the advantages derived from a labour-saving machine, without the intervention of mechanical power, and hence the rapidity and universality of its adoption in London. The growth of London industries since the passing of the Factory Acts Extension Act of 1867 has been something almost passing belief; old establishments have been enlarged and increased year by year, and new workshops and factories have been set up in every district and suburb.

"The sewing-machine has altogether revolutionised the conditions of employment for women and girls immensely to the advantage of the workpeople, and it is to the large increase in the remuneration which women as a class have received, that I think the reduction in pauperism and the improvements which have taken place in the general social condition of the people are to be in a large degree attributed.

The sub-inspector, Mr. Henderson, gives us facts concerning some trades and occupations in London that are of service :—

"1. *Of Artificial Flower Making.*—This is one of the branches of English manufacture which felt the influence of protection up to the latest date. The duty on foreign artificial flowers was abolished in 1860, and for a year or two the trade was so greatly depressed that many never hoped to see a revival. When the Factory Acts Extension Act was passed it had revived, and was being carried on in London on a larger scale than ever. The bugbear of foreign competition was still in the minds of the employers when the restrictive regulations were enforced, and it was with grave misgiving that their influence was anticipated. During the past winter trade has been dull, but artificial flower making is now carried on in this country more successfully and on a larger scale than it was ever known to be before. Before the abolition of protection, English artificial flowers were ugly monstrosities. Now English manufacturers successfully hold their own, and the workpeople during the last ten years have shared in the general advance.

"One employer informs me that the earnings of the workpeople have increased from 20 to 50 per cent. English-made flowers command a much higher price in the market than formerly, but the manufacturers have still to follow Paris for style and fashion. In no trade is it more important for those so engaged to possess an educated taste than this, and a young woman who possesses it will, with a fair amount of practical skill in the manipulation of the materials, make most excellent wages.

"2. *Of Bookbinding.*—In no occupation on a large scale in London has the influence of the Factory Acts Extension Act been more general or more beneficial than in bookbinding. The hours of work prior to 1867 were most irrregular and occasionally protracted, and none are more surprised than bookbinders themselves at the comparative comfort with which their business is now conducted. Publishers make a more even distribution of their work, and authors and printers have learned to be prompt and punctual. Since the passing of the Act of 1867 the normal hours of work in the bookbinding trade have been reduced from 60 to 54, and this has had an influence in equalising the distribution of the work. The men make no objection to work overtime and work more steadily, make more money, in which last particular women share, for they have acquired a very decided advance in remuneration on piece work, which is their usual scale.

"3. *Of Letterpress Printing.*—Few women are now employed in letterpress printing, and the Acts apply to boys. The machines have almost destroyed the necessity for overtime, and when that is necessary adult hands are employed. Web-printing machines, of which we wrote in an article on Caxton two months ago, have quite revolutionised production and its conditions. In wages alone the saving to a morning paper is £100 a week, and the proprietor is, moreover, sure of having his paper out in time.

"Boys in the old time were like Alsatians—not to be controlled, but our awful machines never go on strike or on the spree. The consequence is apparent. Regular hands must be regular, and casuals can be had for night work. The Factory Acts protect machinery, and also on the other side, those who serve machines.

"4. *Factories.*—The condition of needle women excited much sympathy twenty years ago, and we all felt it to be a disgrace to our civilisation. Quietly that condition has been ameliorated, chiefly through the introduction of the sewing machine. Wages then were from 8s. to 10s. per week, and now they are 14s. and 16s. At the machine slow hands will earn 16s., and the best 24s. In collar making wages are rising ten per cent. every year. The dressmakers' earnings have increased more than 30 per cent., and machinists earn 20s. a week. The introduction of piece work instead of time alarmed the workers, and excited anger. The experiment was made at Shoolbred's, and Mr Angus writes :—

"The first two or three weeks very few earned more than the regulation 12s., and some a great deal less. Self-interest soon began to work, and the good and industrious workers drew 20s. per week, and before six months scarcely any one wished for a change. The alteration benefited the workpeople, the firm, and the customers. The workpeople earned more money and were more regularly employed, the firm makes a profit on the labour, a thing not done until the introduction of piece-work, and the customer gains by a large reduction in the cost of manufacture. Since the introduction of the sewing machine there has been a great increase in business."

These are practical facts, and happily we have not to urge

them to inattentive hearers as we did years ago. Machinery enhances the value and lessens the toil of human industry. He who can draw from the inexhaustible recesses of mechanical power, the smallest contribution, confers upon mankind a benefit that cannot be estimated because it is invaluable. It is sure to lead to others of tenfold richness. What impresses one more than any words can express is the cumulative property of invention. It is, if we dare say so, infinite. You find a new application of mechanical power, and in less than a year ten branches spring out of it, making ten more trades, lightening labour, and augmenting profits. The thought startles us. Prejudice declaims. It is nevertheless firm. Machinery is the greatest blessing the Creator has conferred on the children of toil.

There has always been and still is a great difficulty in manufacturing arrangements, arising from the incompetency of science to cope with the question of ventilation. There must be a principle, but it is not known. Every case has to be dealt with upon circumstances, and we are always approaching, but never obtaining solid basis : this is not the position we ought to occupy in an age of scientific invention. Workrooms have only to be looked into by an observer to prove the disgraceful sanitary conditions, which almost universally prevail.

Mr. Likeman sought to improve the ventilation of workrooms in Ipswich, Diss, and Chelmsford, and introduced Howard's patented ventilator, which, by its continuous rotation, sucks up the light air, and without down draught carries it away. The lateral ventilation is effected by placing a tube six inches in diameter inside and close to the wall of the building about six feet high, the lower end being curved and carried through the wall to the outside of the building, and flush with it. This causes a continuous flow of free air to enter the room, which will permeate until the purity of atmosphere in the room is equal to that out of doors.

"The first ventilator was fixed in a large shoe factory in Ipswich in 1871. It has answered admirably, and since then they have been fixed in some printing offices, brush factories, and a cocoa fibre factory.

"My attention has been also directed to the evils resulting from the imperfect combustion of atmospheric gas in tailoring irons, and lately I have succeeded in removing those evils to a large extent in a clothing factory here, where 300 to 400 females are employed.

"Although the building is very large, the atmosphere was charged with a sort of mist, issuing from the gas irons, and watery vapour given off by pressing cloth under wet pads. From these causes, ammonia and damp came from the cloth, smoke from unconsumed carbon in gas irons was in excess, heat from the irons, and the products of combustion of gas all united to give off this mist. I suggested that all the pressers should occupy one end of the room, near to the outer wall. Lateral ventilators, as before explained, were fixed opposite each presser, and bell mouthed ends directed towards the pressers were fixed upon those ventilators.

"By this means the mist was carried off from men's mouths and eyes, fresh air was constantly supplied to them, and great relief was given, especially to their eyes.

"Just about this time an engineer, Mr. Mensing, Crown Street Works, Ipswich, was perfecting his patent atmospheric gas-box iron, adapted for tailors, stay makers, and laundry work.

"He introduced his patent to my notice. I had two applied to the clothing factory where my ventilators were fixed, and after a fortnight's trial I visited the pressers, whose thanks were profuse for benefits conferred upon them.

"Under the old system, men's eyes smarted, were watery and weak ; fatigue was felt by dinner time, and by six o'clock they were quite done up. But now, through the inhalation of free air, dissipation of heat and vapour from the eyes, they are able to work in comfort."

There is a dire tribulation which the regulations can only mitigate, arising from the human poisoning produced by white-lead works. The workers are of a very low standard, and are very reluctant to adopt the prescribed means for their own healthfulness. After all the precautions and preventions there is a rate of fifteen per cent. of lead poisoning. We can scarcely wonder that so low a type of workers is careless and reckless when the barest conditions under law demand the appointment of some one whose duty it is to see them effectually used, that is to say, those who bring their food to the works hand it over to the man in charge of the baths, &c., to be locked up till the meal hour, and it is only returned after he is satisfied that the hands, &c. have been properly washed and the over-clothes removed. Nor is any one working amongst the lead allowed to leave the works until they have thoroughly washed in the acid water. This works well. The old hands know its efficacy, and the young ones are compelled to conform.

And it is a most wonderful development of modern politics, as it is of modern practical science. It does not signify to any one who looks, and learns as he looks whether the taste of the public be inclined to freedom or to bondage ; but any honest observer of the course of political and social law is, so far as law is concerned, bound to the adoption of a principle that is really compulsory. In the school and in the workshop we are sorry to say there is no possibility of evading the beneficence of force ; and no harder charge can be made against the boastful growth of the age than to assert the necessity for compulsion.

THE CHINA CLAY OF CORNWALL AND DEVONSHIRE.

GRANITE is a staple of these counties and from Falmouth 40,000 tons were shipped between 1811 and 1818, partly for building Chatham Docks, and Waterloo Bridge ; a vast treasury of wealth is buried in Cornwall, of which after another half century, we have little conception, wealth that in every case makes riches. We leave material there that might be used, and is not; it undergoes chemical change and is another substance, and that we find to be practically inexhaustible. China clay (petunze) is decomposing granite. In our Journal for April, an article appeared on Pottery and Porcelain, wherein it was shown that Worcester depended on Cornwall, for the clay it required in that elegant manufacture, and now the Paper and Cotton Trades have been prodigiously developed, this substance is advantageously, and sometimes dishonestly employed in those manufactures. The smooth surface of modern papers is much aided by the mixture of 10 or 15 per cent. of this substance, and calicos receive a better finish thereby. Sometimes the paper is overcharged, and will perish—and the calicos and linen will not bear washing. The results are produced by fraud ; and the louder that term is used in such cases the better it will be for individual morality and manufacturing honesty.

In the interval from March 1816 to March 1817, 2,135 tons were shipped at Charlestown to Worcestershire for the China factories, besides 1,775 tons of clay derived from its felspar *(Kaolin)* yielding in royalties £700 a year to the freeholder Lord Falmouth, and then were rated to the poor £150 nett. These figures have now become obsolete. The change in value is enormous and in quantity likewise. In 1832 the export reached 7,000 tons of China-clay, and 5,000 tons of China-stone, forming a very important branch of commerce. Important moreover that in estimating their value to the community, it should be remembered, that they are situated in bleak and barren moors : thus affording employment and support to many hundreds of people, upon a soil that could scarcely support a family.

The origin of these works may be thus described :—A spot being discovered, where China-clay or Porcelain-earth abounds, just as we noticed, in an article on the Derby Factory of Porcelain, was done at Dresden in the old time, the operation is commenced, by removing the vegetable soil and substratum, called by the workmen the *overburden*, which varies in depth from about three to ten feet. The lowest part of the ground is then selected, in order to secure an outlet for the water used in washing the clay.

The *overburden* being removed, the clay is dug up in *stopes;* that is, in successive layers or courses ; and, each one being excavated to a greater extent than the one immediately below it, the *stopes* resemble a flight of irregular stairs. The depth of the pits varies, but seldom exceeds 20 feet.

The clay when first raised has the appearance and consistence of mortar : it contains numerous grains of quartz, which are disseminated throughout in the same manner as granite. In some parts the clay is stained of a rusty colour, of which we shall speak hereafter, from the presence of veins and imbedded portions of shorl and quartz ; these are called by the workmen *weed, caple* and *shell*, and are carefully separated. The clay is next conveyed to the floor of the washing place, and is then ready for the first operation.

A heap being placed on an inclined platform, on which a little stream of water falls from the height of about six feet, the workman constantly moves it, and turns it over with a *piggle* and shovel, by which the whole is gradually carried down into an oblong trench, which is also inclined, ending in a covered channel, leading to the *catch-pits* we will presently describe :—

In the trench the grains of quartz are deposited, but the other parts of the clay, being lighter, are carried away in a state of suspension by the stream of water.

This water is conducted into a series of pits, each of which is about 8 feet long, 4 broad, 4 deep, lined throughout with cut moor-stone, laid in a waterproof cement. The porcelain earth is gradually deposited in these pits. The first collects the grosser particles, which are rejected by means of an opening contrived at the bottom of the pit. The overflow passes into a second pit, and in like manner into a third. These, particularly the second, receive a deposit that even in the old time was preserved, and which is not unknown to us by the term the workmen contrived, *mica*. The water still holding in suspension the finer and purer parts of porcelain-clay, next overflows into larger pits, called *ponds*, which are of the same depth as the first pits, but about three times as long and wide; here the clay is gradually deposited, and the clear supernatent water is from time to time discharged by plug-holes on one side of the pond. This process is continued until, by successive accumulations, the ponds are filled. At this stage, the clay is in the state of a thick paste, and to complete the process, it only remains to be consolidated by drying, and then it is fit for the market.

This, however, is a tedious operation in our damp climate, and is effected as follows: The moist clay is removed in hand-barrows into the *pans*, which are constructed like the *pits* and *ponds*, but are much larger, being about 40 feet long, 15 wide, and a foot and a half in depth. These dimensions may not be absolutely correct, but are very near. When the *pans* are nearly filled, the clay is levelled, and is then allowed to remain undisturbed until it is nearly dry. The time required for this part of the process must depend in a great measure on the state of the weather and the season of the year, because the pans are exposed to the air; during the winter, eight months at least are necessary; whilst during the summer, half that time, or less, would be sufficient.

When the clay is in a fit state, it is cut into oblong masses, and carried to the drying-house, which is an oblong shed, having open wooden-framed sides, constructed in the usual way for keeping out the rain, but admitting the free passage of the air. The clay thus dried is next scraped perfectly clean, and is then packed up into casks and carried to one of the adjacent ports to be shipped for the potteries, or the paper manufacturers, or to the factories in the north. This earth is of a beautiful and uniform whiteness, and is perfectly smooth and soft to the touch.

Among the savans of Cornwall, geological questions continually arise, and discussions of the highest character occur. The subject of the origin of China-clay is one. We have said it is supposed to be the disintegration of granite, but Mr. John Hawkins disputes that position. Dr. Boase, a Cornish geologist of great eminence, defends the accepted idea in the following terms:—

"The gradual diminution in the cohesion of the particles from the solid rock upwards will, of course, support the opinion of either party; but it may be remarked that the solid state of the one, and the disintegrated state of the other, is not the only difference; there is a chemical, as well as a mechanical destruction; for the solid felspar contains an alkali which analysis has not detected in porcelain-earth; and it therefore follows, since an alkali is not present in the perfect *china-clay* as a constituent part chemically combined, that this substance cannot, on account of its great solubility in water, exist in a free state in the mass of china-clay, which, in its native bed, is always wet; for by the constant percolation of water, it would be as effectually removed as in the process itself by which the porcelain-earth is prepared. It may also be observed that the stained parts which the workmen reject under the name of *weed* are of a yellowish or red colour, indicating that the iron contained in the shorl or hornblende has passed into a higher state of oxidation; in the description of these beds of clay, it was noticed that they were bounded by solid granite, and that they were traversed by large masses and veins of quartz, containing shorl. These circumstances furnish another argument against Mr. Hawkins' view, for it is difficult to conceive why the power, whatsoever it might have been, should have acted so partially in its operations as to have consolidated one part of the mass, and have left the other loose and friable. Again, the partially-changed granite, called china-stone, will in time entirely lose its cohesion, as is seen in the numerous masses round the quarries, which, although they retain their form, immediately crumble into pieces on attempting to remove them. And, moreover, the analogy of other rocks afford perhaps the best proof that china-clay is a decomposed granite."

Much inconvenience has been caused in late years by the accumulation of refuse from these works, which are in the neighbourhood of St. Stephen and St. Austell, and extend from Dartmoor all along the granite masses of that district. Being in itself a disintegrated substance, when the manufacturing product is extracted, the remainder is an insoluble volume of particles, and chokes up the courses through which it passes. The chemical analysis made by Mr. Richardson, the Professor at Newcastle-on-Tyne, of the clay is as follows:—

When dried at 212 degrees, two samples were found to contain—

Silica,	46·32	46·29
Alumina,	39·74	40·09
Protoxide of iron,	·27	·27
Lime,	·36	·50
Magnesia,	·44	—
Water and some alkali,	12·67	12·67
	99·80	99·82

And one specimen in the unprepared state gave—

Silica,	35·65
Alumina,	32·50
Protoxide of iron,	1·65
Lime, Magnesia,	traces
Water and some alkali,	30·05
	99·85

The partially-decomposed felspar is known to the workers and manufacturers by the name of china-stone, and is used sometimes by the porcelain workers to add to their ingredients. In the year 1855 there were 60,188 tons of china-clay shipped from Cornwall, against about 2500 in 1816, and to that is added 20,000 tons of china-stone. It has been an increasing trade in the same ratio. This could never have been accomplished but for the adoption of improvements in manufacture. At the Low Moor Clay-works, Mr. Phillips introduced changes he thus describes: "The decomposed felspar is transferred directly from the quarry to the works, where it is thrown into hoppers, and passes into a trough under the action of a full stream of water, encountering on its way a series of knives and iron arms furnished with teeth, which thoroughly beat up the clay in its passage along the trough. Pure spring water is used in the operation, and great care is taken to exclude the surface drainage from the peat soil of Dartmoor. As the water leaves the trough, it flows through sieves, which separate the coarser fragments of quartz, and the fluid, charged with clay and mica, passes on; the mica, breaking up into thin scales, has a tendency to float, but being heavier than the suspended alumina, it gradually subsides under the regulation of the current, which is now not sufficiently rapid to carry on the mica, nor sufficiently sluggish to allow of the deposition of the clay. When at length the stream holds nothing but pure clay, it is allowed to flow into deep V-shaped channels, which terminate in large-covered reservoirs, in which the clay is deposited. Warm air-pipes circulate beneath the reservoir, so as to produce a temperature of about 90 degrees. The fire-clay soon subsides, so as to allow the clear water above it being drawn off." This is an obvious advance on the old method described in the early part of this paper, and which is extracted from the Transactions of the Royal Geological Society of Cornwall; a saving of time is effected that enables the merchants to treble and quadruple their returns. The prevention of the surface-water from getting into the wells is essential. We have seen whole cargoes of china-clay rejected because of the presence of this discolouration. The smallest particle will injure a caskful. Some chemical action is excited in those antagonistic properties, and if it happens to be sent to a paper-maker, he will have no excuse to offer for having spoiled the whole parcel. Iron is death to paper material. It discolours and vitiates more than any other ingredient, and for such purposes as coloured papers, renders it chemically unfit for use, because colours are uncertain where iron is present.

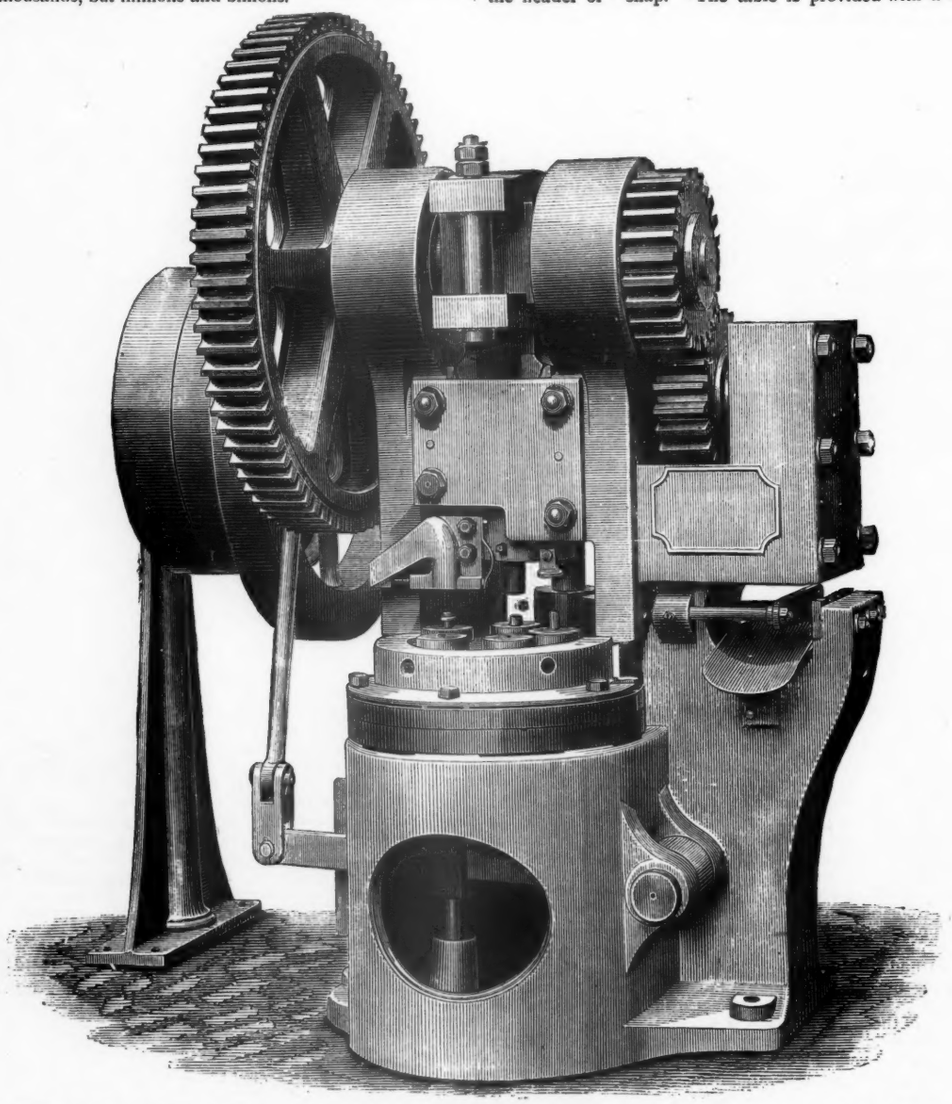
RIVETING MACHINES.

AMONG the many services rendered to mechanical science by Sir Wm. Fairbairn, that of the riveting machine invented by him in 1838, is not the least conspicuous, and in noticing the latest improvements patented by Messrs. Collier of Salford, Manchester, we only trace the progressive nature of all scientific mechanism. This has to do with the making of rivets, and is of course a feeder to the riveting machine. A rivet is a very simple thing: a piece of metal placed in drilled holes and then hammered to connect two plates of metal together. The projecting ends are beaten and form heads by their spreading. The rivet is of essential importance in tank and boiler making, in viaducts and in iron ships.

But this process is clumsy, and when the riveting machine came into use it was soon found desirable to make rivets by

machinery, because in that way greater accuracy and greater rapidity of manufacture became attainable. Mr. Marrow of Sheerness Dockyard invented an excellent one many years ago, which was put into action by means of a pulley, placed upon any moving shaft whatever, whether driven by steam or other power. It was a cumbrous affair notwithstanding, but it enabled one man to make sixty half-inch bolts an inch and a half long, with hexagonal heads, in an hour. This was followed by dozens of others, for the demand for rivets came to be no longer thousands, but millions and billions.

A rivet is a simple thing to look at, but it has puzzled a good many heads, who desired to produce a perfect one. The difficulty of making the head exactly in position with the centre of the shank has hitherto been insurmountable until the introduction of Messrs. Colliers' machine. (See illustration.) It was specially designed to obviate the fault existing in all other previous machines, that of forming the head out of centre. It has a circular table carrying five dies, moved by an intermittent motion, which brings the dies successively under the header or "snap." The table is provided with a locking



motion, which brings each die perfectly central with the "snap," and holds it there firmly and rigidly until the rivet is headed. Thus, if the iron gets a little more on one side than the other when the "snap" comes upon it, it cannot spring the table round and form a crooked head, but simply rights itself by pressure. There is attached an apparatus for cutting the iron into the requisite lengths from the bars, by which any desired length can be made in quantities by an adjustable contrivance. And there is also another contrivance by which the rivets are ejected when finished out of the dies: and there is also a novel appliance for picking up the finished rivets and passing them down a shoot into a trough. No manual labour is required; and in fact it is like a great many works of modern invention: it can do pretty nearly every thing but think. Manifestly, therefore, when perfect accuracy, automatic delivery, and the most wonderful simplicity are the characteristics of an invention —and they are of this,—the world is the gainer, and the manufacturer deserves honour and reward.

HYDRANTS AND WELL ENGINE FRAMES, &c.

HYDRANTS are referred to in another part of this number on the subject of fire brigades; and as the Parliament committee have spoken in high terms of the arrangements made in provincial towns, notably those of Brighton, Manchester, Liverpool, and other large populations, we have availed ourselves of the courtesy of Messrs. Hayward Tyler, & Co., of London, who are the

engineers and patentees of the Brighton method, and offer our description in connection with those illustrations.

Hydrants economise cost in provinces, and for private houses and manufacturing establishments, and therefore should be universally adopted in all mansions, workshops, and factories. There must be a system of hydrants: you cannot obtain pressure without adopting a system. That is expensive, but the cost of adopting a system of hydrants depends on the cost of each hydrant and the number of hydrants required. With respect to the cost of providing and fitting a hydrant, much would turn on the character of the hydrant whether it is simple or elaborate; much on whether any extra work, as the construction of a small branch to receive it, is required; much on whether the hydrant is to be affixed to a pipe already laid down, entailing extra work on the pipe, and breaking up the road and making it good again, which varies according as the material of the road is earth, pavement, wood, or asphalte, and as the road is a crowded thoroughfare or otherwise; for in a crowded street special precautions and night-work at extra pay are indispensable. How wide is the range of cost may be estimated from the fact that the simplest hydrant, as used at Manchester, by itself can be procured for the sum of £1, 10s. 8d., whereas the expense of providing and fitting each hydrant, and doing the necessary work in connection with it in the city of London, will probably amount from £25 to £30.

Hydrants cannot do all that is required of fire engines, but they can do much, as the following extract from the report testifies:—

"The object is not how to deal with fires at their height, but how to quench them at the outset. For the former, engines will always remain necessary; but for the latter they are not available. The engine is at a distance, has to be sent for, and to come; with the utmost expedition it cannot be brought to bear until after the lapse of many minutes. In the meantime valuable property is being burnt, and what was a small fire has become a large one, perhaps a conflagration. A hydrant, on the other hand, is on the spot, and ready for instant service. That it is not so strong as a fire-engine is not a fatal objection; in most cases not an objection at all. The volume which it can discharge may be small, but if promptly used will suffice to extinguish the fire, or to keep it down until the arrival of the engines. So, again, the jet may fall far short of the roof of a house; but the fire is not always at the roof. If the hydrant can throw a jet on the third, second, or first floor, it may do all that is required; and by mounting a ladder or fire-escape with a hose, the person in charge of the hydrant may be able to deliver water through the window at a place unattainable by a jet from the ground. But even as a mere carrier of water to the door of the house the hydrant renders most important service, as by this means hand-pumps can be at once set to work. The efficacy of hand-pumps so used is fully proved by the experience gained at Manchester, where 72 out of 308 fires were extinguished by hand-pumps. In short, the advocates of the hydrant can appeal to what has been well called the axiom of fire extinction, that small means, promptly exerted, are more efficacious than more powerful appliances at a later stage; such axiom depending on the obvious fact that every fire begins by being a small one, and can then be easily dealt with, whereas if unchecked it rapidly gains head, and before long becomes uncontrollable."

These contrivances or machines are so inexpensive as to make it a wonder that they are not universally applied. There are four varying in price from £2 to £3. The first, the Brighton pattern stop valve, fig. 1, with its spigot and fancit, or flanged ends,

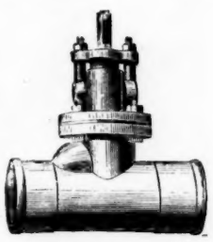


Fig. 1.

and the Brighton pattern hydrant, with sockets and flanged ends. Fig. 2 is a double copper stand-pipe for hydrant, with gun-metal mountings; and fig. 3, a single copper stand-pipe for hydrant, with gun-metal mountings.

The strong copper stand-pipe, with double outlet and single blank cap and chain, has gun-metal mountings, and a valve at the top: screwed London brigade standard thread: and the single is precisely the same except, as its name implies, it has a single outlet. And the purchaser can have these Brighton pattern hydrants fitted with socket or flange bend in cast iron plug boxes, as in fig. 4, which contains all the previous inven-

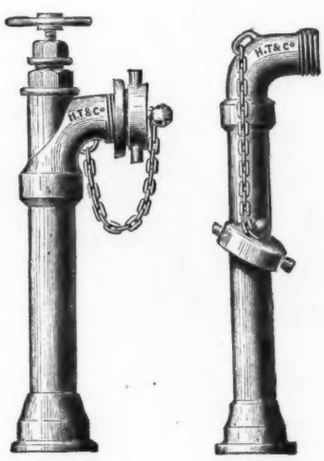


Fig. 2.

Fig. 3.

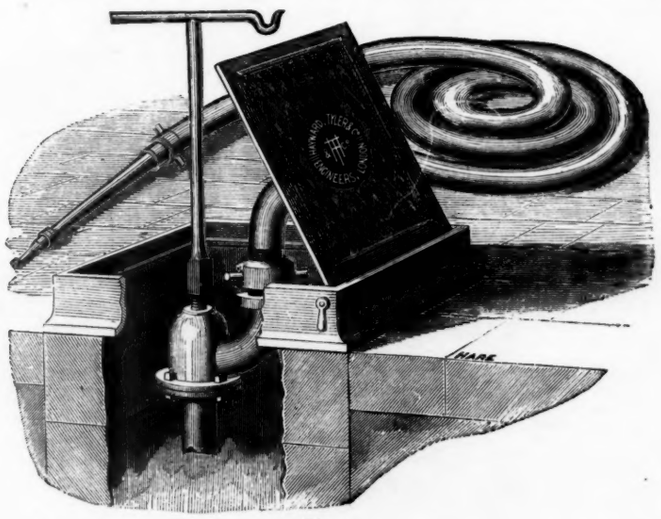


Fig. 4.

tions in a united form. We notice also the improved first hydrant, which may be fixed any distance below the ground; and when out of use, the hydrant and stand-pipe are quite free from water. The inlet is arranged for socket or flange-pipe as may be desired, fig. 5. The improved frost hydrant, fig. 6, can be fixed at any distance below the ground, and is so constructed that when not in use it is free from water. The arrangements for inlet and outlet are complete, and do not depend upon weather. In this department we can only refer to a superior cast-iron pillar hydrant, with union for hose and self-closing lever valve of two qualities, one for ordinary use, and the other for supplying the water carts, or for any other public

services: the other is called a "barrack" stand-post and drinking fountain, fig. 7. This is adopted by the Government at Colchester and other barracks. The arrangements need no other description than ordinary observation can infer from their appearance.

A few pumps and well engines remain to be noticed. First,

Fig. 5.

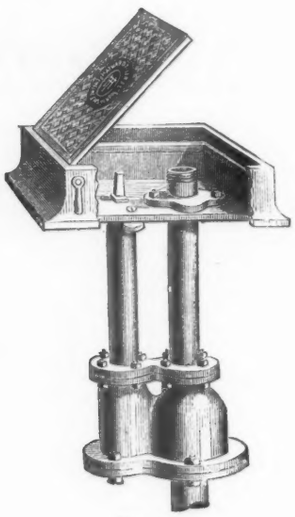


Fig. 6.

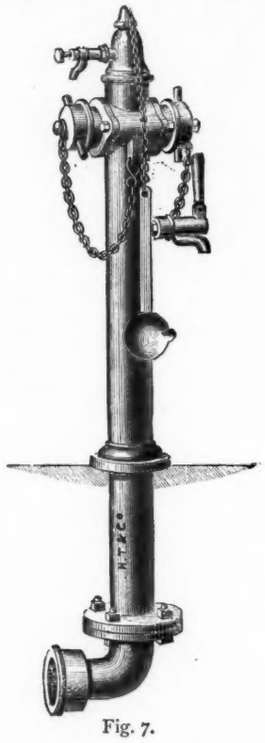


Fig. 7.

a strong portable irrigating pump most conveniently fitted, having all its valves readily accessible, and it has double-barrel plunger or ram-pumps. It is especially to be commended for its adaptation to sewage work, and for operations that are intended to remove foul water, such as in some mines. The construction is simple as to its water-ways, and also with reference to the valvular arrangements: these are contrived to pass a great deal of solid matter without being choked. The next, fig. 8, is a very com-

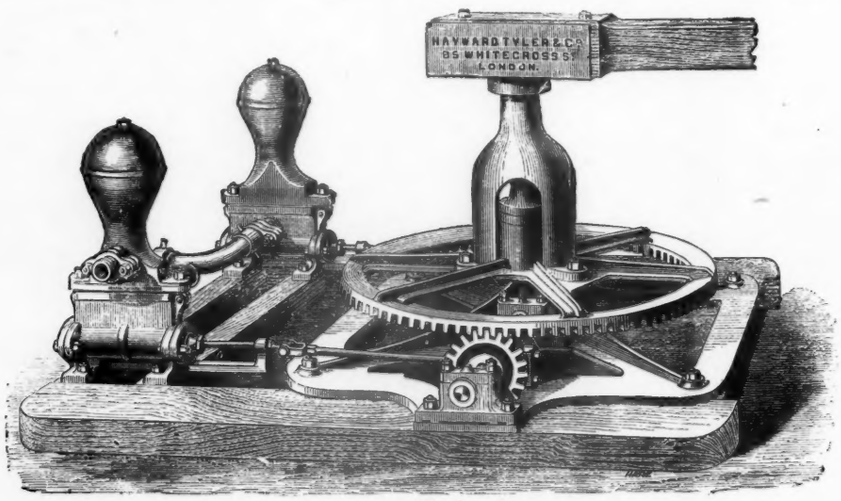


Fig. 8.

plete and portable arrangement, which has been found of great service in supplying houses, in irrigation, and in the distribution of drainage: the whole can be easily put into a cart and conveyed from one place to another. The makers designate it a California pump for horse wheels, to throw large quantities. The illustration has the improved pony-wheel on frame, with double action Californian pumps.

The engineers pride themselves upon the fig. 9, for which they have had heavy orders from the Great Indian Peninsular Company, and other consumers. It is an improved well-engine, with an A-shaped and kite motion, double or treble brass pumps, wrought-iron crank, metal valves, doors to get access to the suction valves, a 4 ft. 6 in. fly-wheel, brass couplings, and a handle on each side. A forty guinea engine, constructed for

adaptation to deep well work, at the least possible trouble, and with much less outlay.

The next illustration is a Well-Engine Frame, fig. 10. The engines, like the last, have been selected by the Great Indian

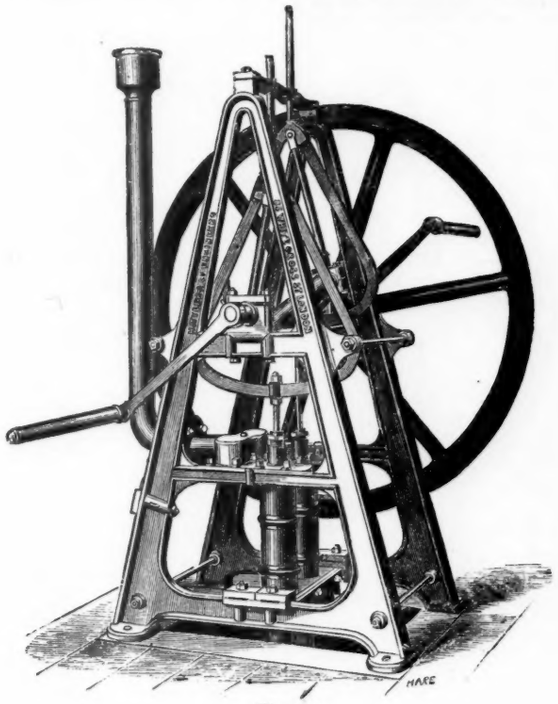


Fig. 9.

Peninsular and other railway companies, and are now extensively used, and esteemed to be the most effective machines yet before the mechanical world for pumping water from wells, and for the temporary supply of locomotives while the permanent works

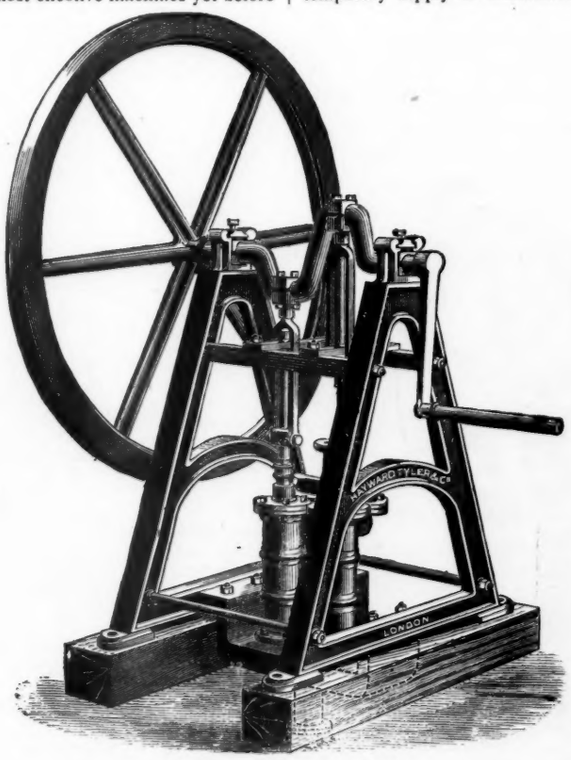


Fig. 10.

are in progress. Railway stations in various parts of the country, private mansions, and public institutions requiring a considerable supply of water, have found in these most satisfac-

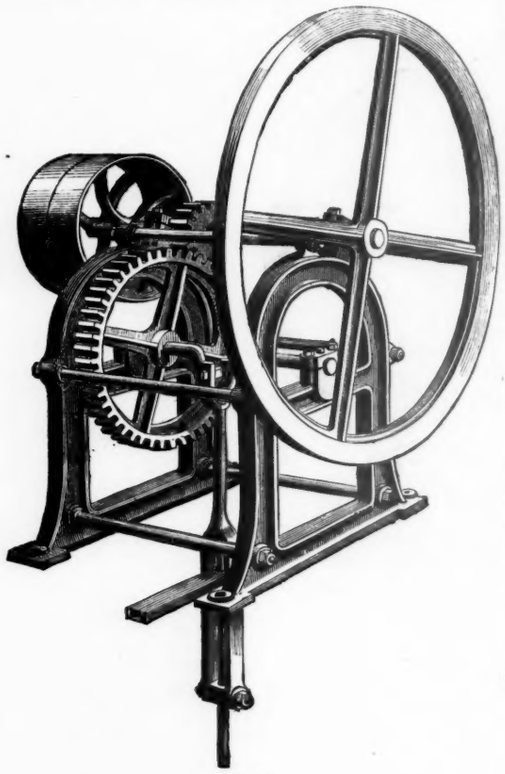


Fig. 11.

tory results, and the arrangement of its parts admit of its adaptation to deep-well purposes.

This extra strong cast-iron frame for well-engine, fig. 11, is the best in all the factory. It contains more variety and power than any other one.

A very interesting fact is continually coming before us in

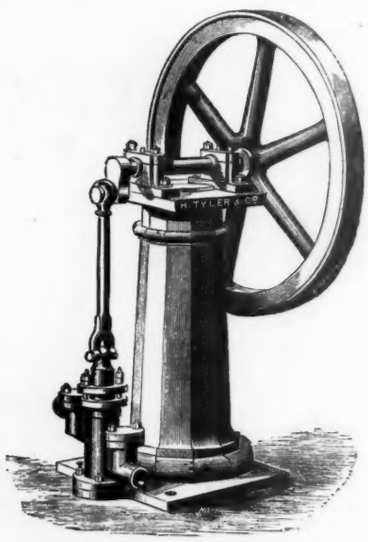


Fig. 12.

reference to machinery inspection; while every effort has been made to work up the quality of hand and horse-power machines to the perfection of those constructed for steam-power, we find great numbers of these fitted for both—that is, if one has a best machine and cannot use steam-power, he is at disadvantage in many instances; but, if his best machine can have the application of steam, he will work on in hope to acquire an engine, and thus having the best hand-power, he acquires the steam-power without forfeiting the outlay he has incurred. The force-pump, "for feeding boilers," as it is termed, is made on this double principle. The pressure is very heavy to those who have not been familiar with such labour, and when a strap goes over the wheel, and it is off, the changed condition of toil makes glad the labourer, and the work is done in half the time. (Fig. 12.)

The triangular cast-iron well engine is the next. The principle is the same, but the appearance is a matter of individual taste, appreciation, and perhaps may depend on surrounding objects. There is also a gothic, but it has smaller wheels: it is really a matter of indifference, except for special positions or purposes. The triangular is the most costly. And lastly, we notice the extra strong cast-iron well engine frame: the difference is, as its name implies, entirely caused by the augmented power. This would be entirely used with steam for motive power. The iron work and pump are made for about five and thirty pounds.

The lift and force pumps, fig. 13, on planks, are familiar to

Fig. 13.

every observer. Mounted on deal plank or oak plank, and fitted on the best of principles with wrought, and not cast-iron, slings and guides and handles, they are among the most useful of the engines any one can have, especially if he have the advantage of a well of water at his command.

The deep-well pumps, fig. 14, are driven by a steam-engine, or by horse-power, or by hand. The frame, which is of strong cast-iron, and the gearing are most admirably adapted to the purpose in hand, and the arrangement is accounted to be one of the best ever placed before the public in regard of combined simplicity and efficiency.

The patent Californian pumps, on horizontal frames or bed-plates, for driving by steam-power, fig. 15, are very powerful engines, most carefully constructed, and of almost universal

adaptation in factories and in warehouses that have to do with manufactures.

We must not omit a notice of the cast-iron sluice-valve, fig. 16, patented by Chandler: it is double-faced, with four gun-metal faces, screw and nut; also made for the Great Indian Peninsular Railway and other companies: one of those undis-

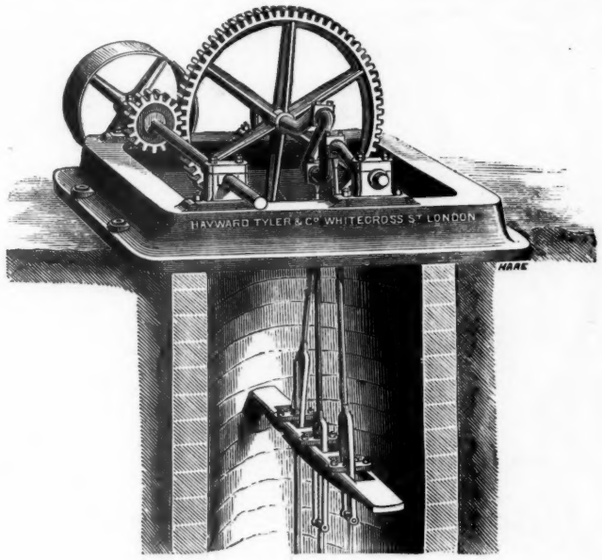


Fig. 14.

tinguished protections which the highest engineering and scientific skill places within the reach of man.

And lastly, fig. 17, we have a simple but most effective fire-cock. You are safe if you have a hydrant, and have this implement in readiness.

The specimens of hydraulic machinery are to be reckoned by hundreds, if not thousands: we have endeavoured to show the variety in principle, taking in this case one maker without disparaging others.

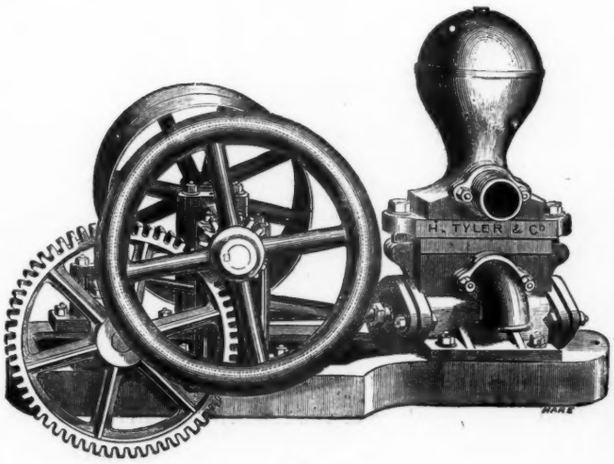


Fig. 15.

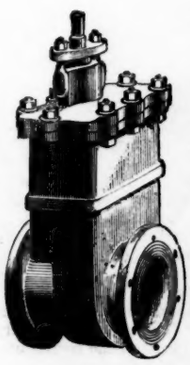


Fig. 16.

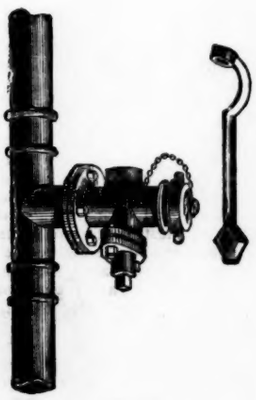


Fig. 17.

THE USE OF FISH SKINS.

FISH-SKINS are commonly classified under the designation of waste products, because it may be supposed that as nobody is at any cost to supply the wants of a fish, and in fact he does not cost any thing beyond the expense of catching him and bringing him home, he may fairly be deemed a waif in creation and all his service so much profit. In the Practical Magazine 1875 we referred to this among other substances at the time an exhibition of such materials took place at Bethnal Green, which exhibition was mainly successful through the knowledge and industry of Mr. P. L. Simmonds. He has now added to that store of information an especial article of a more strictly scientific nature.

Although the skin of some marine mammals, such as those of the seal, walrus, and the white whale, or Beluga (known as porpoise leather) have long been commercially employed, it is only lately that attention has been more generally directed to the utilisation of fish skins on an extended scale. Their employment hitherto has been very limited. Eel skins have been used for the thongs of whips and the attachments of flails, dried sole skins to clarify coffee, and some shark and ray skins by workmen to smooth and polish substances, and also to make a kind of shagreen leather.

At the Maritime Exhibition held at the Westminster Aquarium this year, Mr. G. Kent, of Christiana, Norway, exhibited a variety of tanned skins, among which were :—

1. Whale skins tanned ; the size ranges from 12 inches broad by 60 feet in length, suitable for wheel bands, for driving machinery, &c.

2. White fish, for upper leather, which can be prepared in pieces of 12 feet by 4 feet.

3. Skins of various flat fish, dressed and prepared for gloves. Fine upper leather can be made, often to be had in sizes up to 3 feet square.

4. Skins of soles, dressed and tanned suitable for purses, &c.

5. Skins of thornbacks, suitable for cabinet-makers instead of sand paper, and very much more durable.

6. Skins of eels, dressed and dyed suitable for braces and other purposes.

In Mon. Chas. Varey's "Scientifique Correspondence" from Paris, of August 7, mention is made of an industry carried on at Colborn, in Canada, in the skins of species of Silurids for glove-making, and this is to be prosecuted on a larger scale, both for the flesh for salting and the skin for currying.

Shoes have been made in Gloucester, Massachusetts, from the skins of the cusk or torsk (*Brosmus vulgaris*), the use of which has been patented. If this material for shoes proves what it promises, it will open up a new market for fish skins, which will no doubt be highly profitable. In Egypt, fish skins from the Red Sea are used for soles of shoes. In the Animal Products Collection at the Bethnal-green Museum there are some tanned sole skins shown. The skin of the losh or burbot (*Lota maculata*), cleansed, stretched, and dried, is used by the country people in many parts of Russia and Siberia to trim their dresses; and instead of glass, for the windows of their dwellings, being as transparent as oiled paper. It is also utilised by some of the Tartar tribes as material for their summer dresses, and the bags in which they pack their animal skins. The inhabitants of the eastern coasts of the middle of Asia clothe themselves with the tanned skins of the salmon. It is asserted that it makes a leather as tough as wash-leather. The scale-marks give a very neat pattern to the leather.

W. Brozowsky, in his "Waarenkunde," Vienna, 1869, under "Fish Skin," says it is obtained from the sea angel (*Squalus Squatina*, Lin. ; *Squatina lævis*, Cuv.), the thorny shark (*Squalus acanthias*, *Sq. carcharias*), the tigered shark (*Sq. caniculata*), and some skates, as the angel skate (*Raja rhinobatis*), *Raja Sephen*, &c. The skins of these skates and sharks have spines of different sizes instead of scales. The skins are used for polishing, and, after the star-formed spines have been smoothed down with sandstone, for covering boxes and cases, &c.

The "Waaren-Lexicon" of T. C. Schedel enumerates the following fishes :—Sea-dog (*Squalus blainvellei*, Riss, Aiguillat, Blain), *Sq. acanthias*, and other small sorts, *Sq. carcharias*, Lin., *Sq*, *canicula*, and *Sq. catullus*.

Guibourt (sixth edition, by Dr. G. Planchon, 1870-71, vol. iv.), says, "The Sephen of the Red and Indian seas belonging to the genus *Trygon*, produces the tuberculous and hard skin called Galuchat, after the name of a Paris workman who employed it first. The greater part of the Selacians, viz., the roussettes, sharks, humantins, aigullats, leiches, &c., have a rough skin, which is used for covering boxes and also for polishing wood. The greatest confusion exists among merchants as to the names given to the different skins. Each tradesman applies, according to his fancy, the name of *peau de requin*, *peau du chien de mer*, *chagrin*, and even *galuchat*. I endeavoured to obtain specimens of the various skins, in order, if possible, to determine the species.

"1. Shark skin, from a young shark ; small, imbricated scales, somewhat translucid, with longitudinal lines, the borders or edge entire and circular. This edge is free on the body, but attached on the fins. This skin serves for covering cases, &c., but is not rough enough for polishing.

"2. Skin of mottled *roussette* (*Scyllium*, Cuv.). Tuberculous, imbricated, horny, fine and hard scales, very near one to the other, and transparent, each triangular. Skin much used for polishing. Some persons state that 'false galuchat' is made of it by rubbing off the scales, which leaves a square figure that becomes very showy when the skin is applied on a green paper. I rather believe (continues M. Guibourt) that the false galuchat is made with the skin of the aguillat.

"3. *Peau de leiche* (*Scymnus*), sold to cabinet-makers under the name of *peau de chien de mer*, is covered with nearly rhomboid tuberculous semi-transparent scales, arranged one near the other in quincunxes.

"4. *Peau d' Aiguillat* (*Spinax acanthias*, Cuv.).—Viewed with a magnifying glass, this skin appears covered with small square opaline scales, not rough like the preceding, but much used by the 'gainiers' or sheath makers, for its glossy nacreous aspect.

"5. *Peau de Sagri* (*Spinax niger*, Cuv.). Same uses as the preceding. The word *Sagri* is Persian ; *Sagher*, Turkish, from its resemblance to the dressed leather made from the mule and ass, whence our word shagreen.

"6. *Galuchat* or *Sephen* skin, from the back of the *Trygon Sephen*, Cloq. It has numerous round tubercles, which become white by rubbing down, and in the interior opaque and nacreous. The skin is sometimes dyed for different colours, but it is often preferable to leave it the natural colour by only half polishing it."

The quantity of ray skins, dried or salted, imported into France in 1863 was about 18,000 lbs. weight, principally from Portugal. Formerly they used to fetch as high as 7 frances the pound, now they may be had for 1s. a pound.

The best galuchat, or what we should call shagreen, is made from the skin of the Sephen, which abounds in the Mediterranean Sea, and is also met with in the Red Sea and the Indian Ocean. This skin is remarkable for the size of the osseous protuberances. There are however two kinds of these rays, one with rough skin and the other with smooth.

From a certain portion of the skin of the angel shark (*Squatina angelus*) the Turks make the most beautiful sea-green watch-cases. These sharks, which form a connecting link between the genera of rays and sharks, are found in the Mediterranean principally, and the German Ocean sometimes. The skin being very rough, it is employed to polish wood and ivory, as well as for other uses in the arts.

Turners, ebonists, and carpenters in Europe use the rough skin of the blue dog-fish (*Squalus glaucus*, Linn.) like emery paper, for smoothing their work and preparing it for polishing. This shark skin is also used by the native workmen of the East for polishing wood and ivory, and it is made into shagreen. The best is that obtained from the *Rai Sephen* of India and the Red Sea. That most used now seems to be the skin of the ray (*Hypolophus Sephen*), which is very common on the Malabar coast, and an extensive commerce is now carried on in them in the Indian Ocean ; they are found in the sea of Oman, and also taken at Mahe. The house of Giraudon, 48 Rue Moliere, Paris, makes excellent use of them for morocco and tabletterie.

Peau de Roussette (*Squalus catulus* and *caniculus*, Lin.). This fish, called *chat* at Marseilles, and *crin* in Catalonia, is smaller than the angel fish. The skin, reddish, and without spots, is of a uniform grain, flat, and only used to make cases and other articles known as shagreen. These skins come from the Mediterranean, and are imported in bundles by the sailors, selling, according to size, from 30s. to 36s. the dozen.

Peau de chien de mer is another name given in France to some species of *Squalus* or *requin*. That usually found on the French coasts is known under the names of *chien marin*, *chat marin*, *roussette tigrée* (*Squalus catulus*, Linn.). Turners, cabinet-makers, and carpenters use the skin for scraping and smoothing their work before polishing ; metal workers and others also use it. This skin, when worked up with the tubercules with which it is studded, takes the name of galuchat, and is ordinarily dyed green, to cover cases, sheaths, and boxes. Under the name of *chagrin* these skins used to be much employed in Turkey, Syria, Tunis, and Tripoli. That made in Constantinople was considered the best. It was coloured black, green, white and red.

HEALTH AND SEWAGE OF TOWNS.

REPORT OF THE EXECUTIVE COMMITTEE.

THE Executive Committee report that the Conference applied itself especially this year to the dry systems, as distinguished from the water-carried systems discussed last year, and have passed the following resolutions thereon :—

1. That the pail system, under proper regulations for early and frequent removal, is greatly superior to all privies, cesspools, ashpits, and middens, and possesses manifold advantages in regard to health and cleanliness, whilst its results in economy and facility of utilisation often compare favourably with those of water-carried sewage.

2. That hitherto no mode of utilising the excreta has been brought into operation which repays the cost of collection.

3. That the almost universal practice of mixing ashes with the pail products, though it applies these as a convenient absorbent, and possibly to some extent as a deodorant, is injurious to the value of the excreta as manure.

4. That, for use within the house, no system has been found in practice to take the place of the water-closet.

5. That, although there are appliances and arrangements by means of which the sewer-gases may be effectually prevented from entering houses, they still do so in the great majority of dwellings, both in town and country, including the metropolis.

6. That it is of the highest importance, in a sanitary point of view, that the metropolitan and local authorities should exercise great vigilance with respect to this matter, and that it should be made by law the duties of these bodies to enforce efficient measures for the exclusion of sewer-gases from dwellings, and to watch over their being efficiently carried out under such a system of payment as shall not press too heavily on those at whose charge the work is done.

7. That in every large town plans of its drainage should be deposited with the local authorities, and be accessible to the public.

8. That all middens, privies, and cesspools in towns should be abolished by law, due regard in point of time being had to the condition of each locality.

9. That the annual accounts of the sanitary authorities, especially in great towns, should be prepared and published in sufficient detail.

(Signed by) The Right Hon. JAMES STANSFELD, M.P., *Chairman of the Conference.*
Lord ALFRED CHURCHILL.
Sir H. COLE, K.C.B.
Lieut.-Col. Sir E. F. DU CANE, R.E., K.C.B.
F. A. ABEL, F.R.S.
General F. C. COTTON, R.E., C.S.I.
Capt. DOUGLAS GALTON, R.E., C.B., F.R.S.

HISTORY OF MUSIC PRINTING.

MUSICAL typography rose to the position of an art or calling, under the fostering care of the Italian people. Whatever confusion in the possession of political power happened to occur, nothing affected the love of Song, and the highest culture of every department in the musicial art. The ancient Romans left that legacy, and Italy has continued to be a worthy trustee. Church music, secular music, and, later, stage and instrumental music, emanated therefrom. The market of Italy, however, looked for its supplies to Venice—then the greatest trading city in the world—and the early music printers had their establishments there. The most famous printing and publishing firm of Gardano commenced business about the year 1536, and continued for one hundred and fifty years. From this house Palestrina issued most of his music. Dr. Chrysander is in error in stating that this house had it entire. We have before us three of his published at Rome. The Mass dedicated to Pope Julius III. is a full folio with a very clever emblematical title, engraved on wood in one block 15 inches by 10, representing in the centre the composer presenting his book, kneeling and receiving the Papal benediction; the wide borders top and bottom are mythological, and the sides pictorical musical instruments of every kind. The staves are an inch wide and the text a mixture of Black and Roman moveable types, with initial letters cut in wood 2½ inches in height. Blank lines are inserted to fill up, but these are also of wood and roughly cut. The music is exactly like our moveable music type, but the notes are diamond shape like a gas-meter turn tap, the binding is rough calf correctly tooled. This was printed at Rome by the heirs of Doricus in 1572, and a magnificent edition of Hymns appeared in 1589, in extra folio dedicated. A vol. of Motett's ordinary 4to size, is of the date 1575, and was printed at Venice, "at the house of the heir of Jeremiah Scott." The types are moveable, and so is the text, but the character is common italic. Another of his Motett Books is of an earlier date, 1569, also published at Rome by the heir of Dorico. In that the ordinary Roman character is employed for the text and cast initial letters about 1 inch square. This is the earliest one has seen with that peculiarity. Gardano improved the art considerably by issuing smaller editions, and in separate parts. We now see one Missal in five parts done in four vols., and neatly printed, Roman character for text, and the small form of note type as the others, but this did not appear until 1582, and was followed in 1586 by the favourite oblong 8vo shape, with Italic text beautifully cast. Scott's house printed for Palestrina in 1600, and their work is fully as good as that of Gardano. It is rather sharper than otherwise.

In England the art of music printing made very little progress for a long time. It began truly in 1495, for we find a specimen in the Polychronicon of Ranulph Higden, which was translated by Trevisa and printed by Wynken de Worde, who was the successor of Caxton, and most likely a very much better practical printer than his master. He certainly produced more useful books. This specimen is very crude, but Mr. Ames—a good authority—deems it to be the first of the kind produced in this country, for it was printed at Westminster.

Those rough characters found an improver in Grafton, who, in 1850, issued a volume entitled "The Book of Common Prayer," noted,—a book which was composed by the organist of Windsor, John Marbeck. The volume contains the rudiments of our Cathedral Service, and is of course printed with music; but, to illustrate the utter ignorance of the time in these matters, Wynken de Worde, who commonly added his notes of explanation or correction to the books he printed, added in this case some teaching for the good of the people. He says:—

"In this booke is conteyned so much of the order of Common Prayer as is to be sung in churches, wherein are used only these iiii sortes of notes.

"The first note (like a double square) is a sirene note, and is a breve; the second is a square note, and is a semi-breve; the third a pycke (diamond shape) and is a mynymme. And when there is a prycke by the square note, that prycke is half as much as the note that goeth before it. The iiii is a close (a double square with a tail, and the usual arch over) and is only used at the end of a verse."

Fifty years after, when printers began to rival each other with a spirit never yet excelled, one John Day published a Church Service in four and three parts, to be sung at the morning, communion, and evening prayer; which he followed in 1562 by publishing "The Whole Book of Psalms, collected into English metre by Sternhold, Hopkins, and others, with apt notes to sing them withal;" and in 1575 Thomas Vantrollier printed the Cantiones of Tallis and Bird, under a patent of Queen Elizabeth, which was the first patent ever granted to authors. These music printers were succeeded by Thomas Este, who afterwards changed his name to Snodham, and John Windet, William Barley, and others, who were the assignees of Bird and Morley, the original sole patentees for the printing of music. These do not appear to have possessed any especial claim to notice beyond having been the early English music printers, for they only copied the style of the foreign artizan above-mentioned, and did not in any way improve upon the model. The convulsions of the time gave little encouragement to any one to launch out into enterprise of this description. When James came there was no change for the better, neither could there be in the reign of the first Charles, and still less in the brief period of the Commonwealth. Playford had a patron in Charles II., and elevated the art to the best of his ability. He it was who invented what he called "the new tyed note, wherein by one or two strokes continued from the bottom of each note to the next, the quavers and semi-quavers were formed into compages of four and six, as the time required"—a contrivance that rendered the musical characters much more legible than before. This innovation found acceptance among the Dutch, and also the Germans after them; but even so late as 1724 the splendid edition of Marcello's Psalms was printed by the Italians after the old manner, and so did the Spaniards down to the close of the last century.

Playford appears to have possessed the friendship of most of the eminent musicians of his time, for he published a very great number of books between 1650 and 1685.

All our music was printed from metal types down to 1673, when Matthew Lock's Melothesia appeared, printed from copper.

In our time music printing from type has been revived, after a long interval, when punched pewter plates had universal acceptance. The work in folio issued by Messrs. Parker of Oxford, about forty years ago, followed by that of Charles Knight in the same size, were the means of bringing Mr. Vincent Novello to apply that method in his magnificent labours for the revival of musical taste in all classes of the community. Founts of that type are now to be found in almost all our large printing offices.

Chemistry applied to the Arts, Manufactures, etc.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

POIKILOGRAPHY.—Messrs. Lombardi and Co., the photographic artists, of Pall-mall East and Brighton, have invented a new process of reproducing oil paintings, which is likely to exercise a considerable influence upon the study of art, while it will tend in an extraordinary degree to lower the cost of really fine copies of the works of great masters. The exact nature of

the process is at present a secret, but it is understood that the first stage in the new art is a simple photographic negative from the original painting. The process, however, is necessarily only mechanical to a certain extent, as is manifest at once from the skilful imitation of colour and the success with which the tone of the original work is generally preserved. The specimens which Messrs. Lombardi have accumulated in their studio in Pall-mall East are copies of some of the finest works in the Dresden Gallery, including the famous Madonna di San Sisto of Raphael; the portraits of Charles I. and his Queen, Henrietta Maria, by Vandyke; Titian's Venus crowned by Cupid; the St. Margaret of Corregio; and works of Raphael Naengs, Julio Romano, and Liotard. With these is a reproduction of Angeli's full-length portrait of the Crown Prince of Germany. By selecting in the first instance works of this high order, Messrs. Lombardi are able to show in a striking way the capabilities of the process for reproducing in facsimile the peculiar beauties of oil-painting as expressed by the greatest masters of the art. The variety of texture and surface which the hand of the artist has transferred from nature to the canvas, the half tints deepening into dark shadows, and also the softest outlines, are reproduced with a fidelity which has certainly not been observable in any merely mechanical mode of copying. The process is regarded as specially applicable to the production and reproduction of portraits from life. From the point of view of art study it is more important to observe that it affords a new and valuable means of making known at small cost the art treasures of continental galleries to those who have not the advantage of being able to study the originals. A gallery of fine copies of the best pictures in foreign collections would probably be as popular as it would certainly be a valuable addition to our art exhibitions, and towards this end the process which Messrs. Lombardi have chosen to designate by the somewhat uncouth and not very explanatory name of poikilography—or the art of depicting in diverse colours—marks an important step.

New Paper Materials.—The application of new materials for paper stock, has occupied the serious anxiety of manufacturers for a long time; and the Americans, from their proximity to Jamaica, may perhaps be able to utilise the bamboo cane, which grows there in profusion, and is a good paper making substance, especially for strong and not too fine papers, and probably they will. We doubt whether the cost of transit and charges would not render it unprofitable here. But America in the far west must have enormous quantities of vegetable fibre adapted to the manufacture of best quality paper. It is certain that the servant of the paper mill—the chemist—will have to evolve something for the English market that will yield paper at a less cost than the materials at present employed.

Paper Making Material.—It is stated that white paper of the finest description for writing purposes may be made from the white fibrous root ends of asparagus. As there is a considerable quantity of this fibre to each root, the yield might be expected to be large, and it probably might turn out to be a profitable investment to grow asparagus for the double purpose of providing paper and a vegetable for the table at a cheaper rate than hitherto.—*The Engineer.*

[When will this kind of suggestion cease? Paper can be made from anything vegetable and earthy; but unless the hundreds of persons who have really taken patents, and the thousands who have talked, will take the trouble to know of what they are speaking, they must be content to be classified among the unwise. One mill out of the 400 English mills would require 40 tons a week of asparagus or any other vegetable substance, and want it on a binding contract for at least five years before it could or would touch a change. Who is to find 1000 tons of asparagus ends 'all the year round.'—*Ed.*]

Japanese Copper Metallurgy.—A brief article in the *Berg-und Huttenmannische Zeitung*, by Uwao, Imai, of Freiberg, gives an interesting account of the early copper metallurgy of the Japanese, taken from a Japanese manuscript, the date of which Mr. Imai does not give, but which he seems to consider as belonging to the seventeenth century. He points out as noteworthy that, although the ancient Eastern practice was the outgrowth of blind experiment, without scientific knowledge, the method adopted nearly coincides in principle with that of the reverberatory process of Europe. The ores treated contained silver and lead besides copper, and sometimes antimony and native copper. The following description of their treatment, from the *Engineering and Mining Journal*, is translated from the German of Mr. Imai:—"The procedure in reduction varies, for there is copper which can either be forged or cast. That which contains silver and lead is of soft nature, and is hence forged into sheets and drawn into wire. With antimony it is harder and brittle, and cracks in forging, wherefore it is suitable neither for sheet nor wire. When lead and tin occur in the copper, it is called karakane—bronze—and used in casting bells and for mirrors. The ores, roasted in heaps, are charged alternately with charcoal into a hearth, which is supplied with blast by means of two bellows. A workman occasionally stirs the charge, and draws off the slag, whereupon the molten matter which has been formed is sprinkled with water, and taken from the hearth in cakes. The extraction of the copper from the matter takes place in a similar hearth; only the charge is covered when the materials have become molten. After drawing off the slag, the black copper is removed from the hearth. This the private works were not in those days permitted to do, being obliged to deliver it to the copper works at Oosaka, where it was refined and sent to Nagasaki for barter. The black copper was re-molted, according to its fineness, once or twice in crucibles, and tapped, after the removal of the slag, into moulds filled with boiling water, where it was then cooled with cold water. Still earlier, in the sixteenth century, it was not practicable to extract silver from copper; but subsequently a native of the province of Isumi, by the name of Sumitomo Siusei, learned from a foreigner the following process of desilverisation: the copper was smelted with lead, the slag drawn off, and an iron bar plunged into the bath. The alloy which clung to this bar, containing 80 per cent. of copper and 20 per cent. of lead, was treated by eliquation, and the eliquated lead was cupelled in a rude furnace upon a hearth of ashes.

Ruthenium.—MM. St. Claire-Deville and H. Debray have recently reported on the physical and chemical properties of ruthenium. They find that the metal forms an oxide RuO_2, thus differing from osmium. By fusing the pure metal with potash and saltpetre, then saturating the rutheniate thus formed with chlorine, and distilling in a current of the gas at about 80 deg. C., they obtain the tetra-oxide RuO_4 in yellow crystals, which, when reduced, yields the pure metal. The metal they obtained by purification from its alloy with zinc, was found to have a density of 12·261 at 0 deg. They also obtained a compound, $Ru_2K_2O_8$, in black crystals, on saturating the rutheniate of potash with chlorine. For the analysis of ruthenium ores, the process they employ is based on the foregoing remarks. After the fusion of the ore with saltpetre and potash, the whole mass is distilled with chlorine, the excess of gas, together with the RuO_4, being absorbed by solution of potash. The potash solution is then treated with alcohol which precipitates the ruthenium as oxide, and this is finally reduced to the metallic state with hydrogen.

New Zealand Iron.—Some sample pig iron produced by the New Zealand Titanic Steel and Iron Company has, according to the *Iron and Coal Trades' Review*, been sent over to this country for the purpose of being tested. The iron is smelted from metallic iron sands, which are found along the shores of Taranaki beach. On analysis it has been discovered to consist of magnetite, 71·0; titanium, 8·0; and quartz, &c., 21·0. When manufactured it has a close grain and brilliancy of polish, being regarded as a superior metal for the finer classes of cutlery and edge tools. The above-mentioned company, who have recently built two blast furnaces, sent some sample pigs to Messrs. T. W. and J. Walker, merchants, at Wolverhampton, who entrusted them for testing purposes to the Shelton Bar Iron Company at Stroke-upon-Trent. The pigs on being broken exhibited mottled fracture. In the puddling furnace they worked well into wrought iron, and as they were slender—averaging 78 lb. each against 1 cwt. generally—did not occupy too much time in the working and balling up. The heat was divided into two balls and rolled into a couple of 4in. bars, ⅝ in. thick. In the process of puddling, much thick cinder was evolved, which, taken in conjunction with the smallness of the quantity of pig work, accounted, no doubt, for the deficient yield. This was found to be at the rate of 1 ton 3 cwt. 3 qr. 14 lb. of pig iron to the ton of puddled bars produced, or nearly 20 per cent. loss, while ordinary good and sound pigs lose about half the percentage. The pig iron weighed 2 cwt. 0 qr. 10 lb., and the puddled bar produced was 1 cwt. 3 qr. The puddled iron was afterwards worked in the bar mills in the regular way into 1 in. round and 1½ in. flat, pieces being cut off for testing in various ways. The hot testing process showed the iron to be perfectly free from red-shortness, whilst the cold tests showed freeness from cold shortness. The tensile test indicated that the iron was exceedingly ductile, the flat having contracted in area nearly 50 per cent., and elongated over 31 per cent., or 3¾ in. in a foot. The ultimate stress was also very good, being respectively 23 and 23½ tons per square inch. Most of the trials were the British Admiralty requirements for

"best best" bar iron, whose tensile is 22 tons per square inch, whereas the iron in question stood 1 and 1½ tons above that. The iron is considered remarkably well adapted for the better classes of engineering and smith work, and the specimens have stood the trials exceedingly well.

Bressemer Steel Production.—Some interesting and striking facts in connection with the Bessemer steel trade have just been published by the *Moniteur des Intérêts Matériels* of Brussels. From the statements made by this journal, it appears that in the province of Liége, the production of Bessemer steel during 1875 was 47,200 tons, of the value of 14,124,000f., whereas the value of the 72,500 tons produced in 1876 was only 15,570,000f. From these figures it is deduced that the average prices at the works were 427f. per ton in 1874, 299f. in 1875, and only 215f. in 1876, the value having thus fallen 50 per cent. within a period of two years. The whole production of iron and steel in the entire world in 1873 was 10,450,000 tons, of which Europe was credited with 8,600,000 tons. In 1875 Europe only produced 7,900,000 tons, including 1,400,000 tons—or 17·70 per cent.—of steel. The total consumption of Europe in the same period was 6,700,000 tons, so that the inference is drawn that the production exceeded the demand in 1875 by 1,200,000 tons, the cause being "no other than the introduction of Bessemer steel." The manufacture of this steel began to develop in 1870, and has since been so rapid that there are now ninety-four Bessemer steel works, employing 317 converters, in existence. Estimating the production of each of these converters at 10,000 tons annually, which is said to be about the average of Belgium, but probably below that of the United States, the existing Bessemer steel works would be able to supply a demand for 3,170,000 tons annually, or fully 50 per cent. in excess of the demand. We know very well that such is not the case, for the simple reason that the greatest iron and steel producer of the world—England—is in Europe, and she sends a very large proportion of her iron and steel manufactures to every part of the globe, which is thus probably accountable for the surplus which so greatly troubles our Belgian contemporary. Fifty per cent. indeed! and where is it? And what about the pseudo-inventors who are manufacturing Cleveland pig, and claiming to be inventors, after having apparently taken advantage of expired patents? Do they make nothing? If they are at work, there must be only about two millions of tons of steel in the market wanting purchasers!

Electrical Light.—The electrical illumination of the Lyons railway station is being completed. They are now using twelve electric lamps. This number will be enlarged successively to twenty-four lamps, fed with one light-producing and one light-distributing machine. It is believed that 22-horse power will give a power of 2400 gas-lamps, using 100 litres each per hour.

Hardened Caoutchouc.—The heat conductivity of hardened caoutchouc has, we read in *Nature*, been recently determined by Prof. Stefan, of Vienna. With six plates of equal thickness a parallelopipedal vessel was formed, and arranged as an air thermometer. The apparatus having acquired the temperature of a regularly-tempered room, it was inserted quickly in a vessel of broken ice; the time of insertion, and the position of the mercury in the manometer immediately observed, and then the times noted at which the mercury reached particular heights. The thermometric conductivity was found about $0{\cdot}000928 \frac{cm^2}{sec.}$. Taking the specific heat of unit mass of vulcanised caoutchouc = 0·23, and the specific gravity = 1·22, it follows that the thermal conductivity = 0·00026.

Sketching Colours.—We recently received from Messrs Lechertier, Barbe, & Co., of 60 Quadrant, Regent Street, W., a little box of moist colours intended for beginners. This little box is of metal, of the usual moist colour box shape, contains ten colours—all, we are assured, with the exception of the sepia, which is a genuine compound, pure unadulterated pigments—and three brushes, and costs 1s. We have tried it practically, and find it decidedly good—remarkably good indeed, considering the price. It is very portable, and will be found quite sufficient by most painters for sketching purposes.

Danger of Using Anthracite.—At the Brookfield coal mine, near Wheatland, Pennsylvania, on the Erie and Pittsburg Railroad, the coal is hauled out by a locomotive engine. One morning the managers of the mine ordered anthracite coal to be burned in the engine furnace instead of soft coal, heretofore used. The engine passed into the slope, and after being in a short time, the men in charge of the engine became suddenly affected by the gas from the hard coal, causing them to fall to the ground in a senseless condition. The driver managed to make his way back to the mouth of the bank, and gave the alarm, at which a large number of men rushed into the bank to rescue their comrades. One after another they passed in, but were almost immediately overcome by gas, and they, too, fell insensible. After several had thus fallen, a gang was organised to rescue those who went in last, and squads of four or five passed in, until they came to a fallen comrade, when they would take him in their arms and carry him out to the open air. In this way thirty-six men were brought out, six of whom were either dead before reaching the mouth of the bank or died immediately after.

[This must be further investigated; there is more to be said than what is hastily concluded about the cause being anthracite. —ED.]

Popular Science.—A paragraph has lately been going the round of the daily and weekly press, stating that an ounce of gold could be *beaten* so thin that it would cover ten acres of ground. The absurdity of this will be at once apparent, when we remember that the thinnest leaf of beaten gold ever yet obtained was somewhat thicker than the 300,000th of an inch. An ounce even of Faraday's transparent films, obtained by chemical means, and estimated by Crookes at the 3 millionth of an inch in thickness, would only cover about the 20th part of an acre.

To Make Lime Cylinders for the Oxyhydrogen Lamp.—These are generally made in a cylindrical mould, and the central hole drilled through them afterwards. This after-drilling renders them very liable to split; the following method has therefore been devised to avoid this defect. The apparatus consists of a thick brass plate, with a deep hole drilled in the centre, into which fit the wire which is to form the hole in the cylinder. A piston, consisting of a hollow tube with a disc at the lower end, fits over the wire and into a movable brass tube the exact diameter of the lime cylinder, but a quarter of an inch longer. The mould is placed in position, and the mixture of lime and grain is packed in all round the wire, the piston being firmly pressed down from time to time. When the lime cylinder reaches within a quarter of an inch of the top of the tube, the whole is removed from the base-plate, the cylinder being pushed out of the mould by the piston, and the wire carefully withdrawn. It is then set to dry in slowly, but thoroughly in a warm place. Although called lime-cylinders, they are really made of calcium carbonate (common whiting or chalk). Precipitated chalk, which may be obtained at any chemist's, is the best form of calcium carbonate to use when a slight extra expense is of no consequence. It is made into a paste of the consistence of new putty with thin mucilage of gum arabic. The mucilage must not be too thick, or it introduces too much organic matter into the flame, giving rise to an irritating odour, besides increasing the tendency of the cylinders to split. The exact proportion of gum in the mucilage can only be ascertained by experiment. Sufficient pressure must be exerted in forming the cylinders, so that they may be thoroughly compact and firm, and above all, they must be slowly but thoroughly dried. Their size, of course, depends upon that of the gas-jet to be used. They should be kept for use in a warm dry place, surrounded by precipitated chalk, in a closely-stoppered bottle; but of several hundreds made in this way, and submitted to the most rigorous tests, not one has proved a failure.

Impurities in Zinc White.—A sample of zinc white lately analysed by Mr. W. W. Stoddart, F.C.S., of Bristol, was found to contain nearly 10 per cent. of zinc sulphite, which rendered it totally unfit for mixing with white lead as a paint. The sample came from a continental house, and the sulphite evidently resulted from the zinc ore (sulphide of zinc) having been insufficiently roasted, and hence only partially oxidised. The impurity may be readily detected by pouring nitric or hydrochloric on the sample, when sulphurous fumes will be at once given off.

Another Musical Telephone.—An American electrician, Mr. Harris of Lafayette, Indiana, has invented a new transmitting instrument for the musical telephone of a very simple character. It consists of a brass tube about 4 inches in diameter and 7 inches in length, closed at one end with a thin metal diaphragm. The tube is mounted on its side upon a base-board, a pointed rod adjustable by a screw being just in contact with the centre of the diaphragm. The rod is connected with the line-wire, and the tube with earth. By humming or singing into the open end of the tube, the vibrations of the diaphragm, are communicated to any similar instruments that may be

placed in circuit. By using long and short sounds for the dash and dot messages may be sent by the Morse code. Although harmonic vibrations are readily transmitted through a hundred miles of wire, the instrument does not seem capable of conveying the ordinary sounds of the human voice.

New Enamel for Cards, &c.—The *Journal of Applied Science* gives the following receipt for an enamel for cards, which has the merit of being cheaper and more easily prepared than those at present in use. Twenty-four parts of solid paraffin are melted in an open vessel, and a hundred parts of the whitest china-clay (kavlin) are then stirred in. The china-clay must be extremely fine, and before using it should be thoroughly dried and heated up to the melting point of the paraffin. When cold, the mixture is ground in an ordinary paint mill. For use, it is mixed into a thin cream with warm water, and applied in the same way as other enamels. Containing no metallic compound, it is not liable to discolour in foul air, and is non-poisonous. This enamel is capable of being treated with any colour that may be desired.

Economical Soap.—A soap manufacturer of Tilsit has brought out a new cheap soap, in which about 10 per cent. of the alkali is replaced by fine wood sawdust. The sawdust of course acts as a mechanical detergent. The price of this soap is about 20 per cent. below that of ordinary washing soap, and its detersive qualities are said to be increased by the additional ingredient.

To prevent Silver Goods from Tarnishing.—Silversmiths have always found great difficulty in keeping their silver goods from tarnishing while they are exposed in their shop windows and show cases. No matter how nearly air-tight their fittings may be, the sulphurous fumes from the gas and sewers will always more or less penetrate the tightest cases, leaving marks on the frosted portions of their works, that necessitate their being returned to the manufactory for refinishing. A number of varnishes and other materials have been used for covering the goods, but without success. A German manufacturer, however, has found that weak collodion may be brushed over any part of the silver whether matt or polished without interfering with its beauty or colour. When the goods are sold the collodion film may be washed off with a little ether and alcohol.

"Slip" in Locomotive Driving Wheels.—When the driving wheels of a locomotive revolves without biting the rail, the circumstance is generally looked upon as being accidental. A paper published in the *Comptes Rendus* of the French Academy of a recent date, by Mr. Rabeuf, detailing some experiments made by him on various locomotives, seems to show that the occurrence is more general and complex than has hitherto been supposed. In making a trial of a new express engine, made for the Chennis de Fer du Nord by the Alsacian Company, M. Rabeuf found a very considerable amount of slip on descending a gradient of only 5 in a thousand. The driving wheels of the engine were 2 metres, 10 centimeters, in diameter, and the engine and tender weighed 27,000 kilograms. A total speed of only 120 kilometres was obtained on this incline, the wheels revolving at the rate of 360 revolutions per minute, the latter figure showing that a speed of 143 kilometres ought to have been attained. The loss by slip therefore was 23 kilometres or about 19 per cent. M. Rabeuf was somewhat astonished at this result, and at once instituted a series of experiments on engines of different weights and powers. He found that in descending gentle inclines the amount of slip varied between 13 and 25 per cent., or on an average 20 per cent., while on the level or on an ascending gradient it was nearly *nil*. As 20 per cent. loss of power means an equal loss of fuel, the matter requires close investigation.

Aniline Dyes.—There has been at various times much discussion on what may be termed the sanitary aspect of the aniline dyes. Although it may be at first difficult to see in what way the colour of an article of costume can possibly affect health, yet the relation of the one to the other is not so remote as might be anticipated. Socks, stockings, and gloves are worn next the skin, and poisonous matters may thus be brought into the system; even the very wear and tear of ordinary articles of costume, in the event of the colour not being of a very firmly adherent nature, results in a portion of colouring matter being liberated in the form of a fine dust, and thus inhaled by the lungs. In France stringent measures have had to be adopted to prevent the artificial colouration of cheap wines with "fuchsine." Recent experiments have now beyond doubt established that aniline dyes, at least, the reds and blues, are in their pure condition comparatively inert, and that the ill effects which have been sometimes attributed to the use of these dyes are traceable, not to the pure colouring matters themselves, but to traces of arsenic which they contained, and which arose from inefficient purification subsequent to manufacture. Enterprising scientists may always be found who are willing to become martyrs, for science or for notoriety, and the present inquiry has had its self-sacrificing hero in the form of Herr Seidler, of Riga, who administered to himself three-quarters of a grain of aniline red every morning, for a period of five weeks, without any ill effects. When it is pointed out that a single grain of aniline red is said to be sufficient to impart a good pink colour to fifteen gallons of alcohol, it would be necessary to drink an enormous quantity of artificially-coloured wine in order to equal a single morning performance of Herr Seidler. So far the question is practically settled, the only remaining difficulty being our inability to ascertain whether pure or impure colouring material has been used in any purchased article; and it will therefore be better, as a simple matter of precaution, to be on our guard against the indiscriminate use of aniline dyes for colouring purposes.—*Medical Examiner.*